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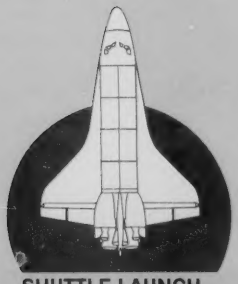

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By arrangement between NASA and the Smithsonian Science Information Exchange (SSIE), a separate section of information on aerospace-related *On-Going Research Projects* is inserted into each issue of *STAR*. The insert presents titles of active NASA grants and university contracts, summary portions of recently updated *NASA Research and Technology Objectives and Plans (RTOPs)*, and notices of non-NASA research projects that were funded in the most recent or current fiscal year. The latter are selected by SSIE. The project announcements in the insert are arranged by *STAR* divisions but are otherwise entirely separate from *STAR*. They are not indexed nor machine-searchable by NASA. Current and retrospective searches are available from SSIE, 1730 M Street, N.W., Washington, D.C. 20036.

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Subject scope of *STAR*, *IAA*, and *On-Going Research Projects* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

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For related information see also *34 Fluid Mechanics and Heat Transfer*.

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Includes aircraft simulation technology.

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06 AIRCRAFT INSTRUMENTATION 858

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For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

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Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 THERMODYNAMICS AND STATISTICAL PHYSICS 984
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 984
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 985
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software*.

83 ECONOMICS AND COST ANALYSIS 986
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE 986
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 986
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 987
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS N.A.
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 987
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 988
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 988
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL 989

Note: N.A. means that no abstracts were assigned to this category for this issue.

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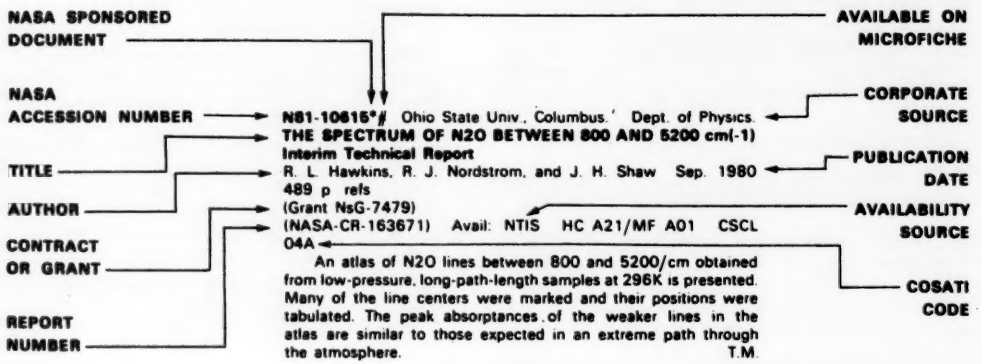
TYPICAL CITATION AND ABSTRACT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N81-10615*# Ohio State Univ., Columbus. Dept. of Physics.
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THE SPECTRUM OF N2O BETWEEN 800 AND 5200 cm(-1)
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Interim Technical Report
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An atlas of N2O lines between 800 and 5200/cm obtained from low-pressure, long-path-length samples at 296K is presented. Many of the line centers were marked and their positions were tabulated. The peak absorptances of the weaker lines in the atlas are similar to those expected in an extreme path through the atmosphere. T.M.

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, NAVY ENVIRONMENT - TRI-TURBO PROP AIRCRAFT

B.M. Buck, Polar Research Lab. Inc., *123 Santa Barbara St., Santa Barbara, California* 93101 (DN975107; N00014-79-C-0002)

In response to the 5-year Arctic Planning Guide (AD OPNAV Inst. S3470.5), the Arctic Research Program is shifting from the western Arctic to the eastern Arctic. This redirection requires a change in the traditional reliance on NARL and its fleet of short range aircraft. This proposal is to introduce the tri-turbo prop aircraft into use as a logistic support platform over a 3-year period from 1 March to 30 May annually for about $250,000 each year.

This aircraft would be, as its capabilities are demonstrated, folded into the logistic support plans for FRAM I, subsequent field efforts in FY 80-85. The funds provided would configure the aircraft for polar operations including specialized land gear equipment, navigation and communications equipment and a cold weather package. The funds would provide about 270 flight hours per year over the three year period.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0002, COMBAT MAINTENANCE CONCEPTS AND REPAIR TECHNIQUES (FLUID LINES, CONTROL TUBES)

J.R. Yaeger, Raychem Corp., *300 Constitution Dr., Menlo Park, California* 94025 (DA0G0463; DAAK51-79-C-0059)

To determine the feasibility of using shape memory alloys (SMAS) to repair helicopter fluid lines, control tubes and drive shafts.

The effort shall be performed in two tasks. In Task I, tabular and C-ring SMA coupling designs will be evaluated for application to repair the selected helicopter components. Emphasis is placed on strength of materials, ease and speed of installation and economics of manufacture. In Task II, SMA test samples will be fabricated tensile and compression tests for the control tubes and torque and balance tests for the tail rotor drive shafts. In addition to the above, flameless heating techniques will be considered and a prototype device will be evaluated.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0003, PREDICTION AND EVALUATION OF THE PRESSURE FLUCTUATIONS IN THE B-1 WEAPON BAYS

A.G. Tipton, Rockwell International Corp., *International Airport, Los Angeles, California* (DF143330; F33615-79-C-3208)

Internally carried weapons can be exposed to very intense fluctuating pressures when the weapons bay doors are opened during flight for weapon ejection. The fluctuating pressures have been severe enough to cause damage to the weapons as well as the aircraft structure itself. Current methods used to predict these fluctuating pressures are based almost entirely on wind tunnel data with very little flight data to verify them. They also do not consider the effects of suppression devices. The objective of this effort is to systematically correlate and document the weapons bay data acquired during development of the B-1 aircraft and then verify and/or modify the current prediction methods. The results of this effort will significantly increase the confidence in the prediction methods utilized to determine the fluctuating pressures in aircraft weapon bays with and without suppression devices.

All of the B-1 weapons bay wind tunnel and flight data will be evaluated and correlated. Current empty cavity prediction methods will be verified and/or modified utilizing the correlated results. Prediction methods which account for stores and suppression devices will be developed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0004, EXTENDED LIFE AEROCONICAL PARACHUTE

L.C. Wickman, U.S. Dept. of Defense, Navy, Naval Weapons Center, *China Lake, California* 93555 (DN895417)

Establish feasibility of sealed plastic technology/vacuum packaging of the aeroconical parachute canopy for extended service in the operational environment.

Hermetically sealed vacuum/pressure packaging techniques and aerospace plastics will be applied to packaging the new aeroconical parachute. 'One-time' factory packaging with strict Q.C. will be used to obviate the necessity for repacking. Test units will be manufactured, and subjected to environmental, flight tests and ejections to prove the concept feasible.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

1.0005, AUTOROTATION MANEUVER CHARACTERISTICS OF HELICOPTERS

R.E. Studwell, United Technologies Corp., Sikorsky Aircraft Division, *Sunnyvale, California* 94088 (DA0D4077; DAAJ02-76-C-0066)

A mathematical model for evaluating the autorotation landing capability of current and future army helicopters shall be established. An analytical investigation will then be conducted to delineate the sensitive parameters and limits that affect the quality of the autorotative entry and landing of helicopters.

The modification of an existing analytical method shall be performed resulting in an efficient and economical computerized mathematical model for the evaluation of the autorotative capability of current and advanced helicopter systems. Through the previously modified computer evaluation technique, sensitive or limiting parameters affecting AH-1G, UH-1D, OH-6A, and OH-58A helicopter autorotation entry and landing capabilitiies will be determined with baseline aircraft results compared with flight test data. In addition, an autorotation landing index based on energy and time factors shall be computed and catalogued for the subject baseline helicopters.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0006, WIND TUNNEL EVALUATION OF AN AEROELASTICALLY CONFORMABLE ROTOR

R.H. Blackwell, United Technologies Corp., Sikorsky Aircraft Division, *N. Main St., Stratford, Connecticut* 06602 (DA0E3778; DAAJ02-77-C-0047)

Investigate the ability to improve rotor operational qualities (i.e., performance, efficiency, loads, stability and handling qualities) by deliberately designing aeroelastic properties to exploit the inherent tendency for blades to deform elastically. Determine if significant practical improvement can be made in rotor operational qualities reliability and maintainability, and cost. This effort will be directed toward generation of advanced data pertinent to advanced army aircraft, including UTTAS, AAH, and ASH.

Conduct thorough review of effects of aeroelastic properties on rotor operational qualities. Select specific significant parameters and objectives which can be evaluated with existing technological capability. Perform rigorous phenomenological studies of the results of parameter variations using advanced analytical tools. Design and fabricate wind tunnel models, and perform comprehensive tests to substantiate analytical findings. Carefully review results to determine specific parametric trends for improving rotor design. Where practical, interpret trends in terms of full scale design characteristics which may be applied in aircraft development.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0007, NAVY VEHICLE DESIGN AND CONSTRUCTION - VORTEX/WING VISCOUS INTERACTION THEORY AND ANALYSIS

C.J. Dixon, Lockheed Georgia Co., *86 S. Cobb Dr., Marietta, Georgia* 30060 (DN475229; N00014-74-C-0151)

The objective is to expand the understanding and knowledge concerning the creation, development and stability of leading edge and other wing intersecting vortices, and to develop the analytical tools to explore these phenomena for the design of tactical aircraft wings, utilizing optimized wing-vortex interactions for improved aerodynamic efficiency.

The approach is to refine and improve the viscous numerical model developed under the conraact, and to use that model to investigate the effects of vortex formation, strength, position, growth or decay, and incipient burst, on the lifting-surface interacting vortex. Specific knowledge concerning the critical leading edge conditions and typical boundary conditions is to be obtained through wind tunnel tests and boundary-layer computations in the leading edge region. The viscous numerical model is being coupled with a potential flow model to provide complete aircraft forces and moments.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0008, DEVELOPMENT OF COMPUTER-GENERATED PHENOGRAMS TO FORECAST REGIONAL CONDITIONS HAZARDOUS TO LOW FLYING AIRCRAFT

W.E. Southern, Northern Illinois University, School of Liberal Arts & Sciences, Dept. of Biological Sciences, *DeKalb, Illinois* 60115 (DF049880; AFOSR-77-3431)

AF function - bird strike continue to pose a major hazard to aviation, especially to high speed, low altitude aircraft. The cost of bird strikes in civilain and military aviation vastly exceeds that of any agricultural or other economic problem created by birds. Deficiency - military aircraft often fly at low altitudes and at high speeds to avoid radar detection. Bird concentrations by non-migratory species are relatively easier to anticipate than migrating species and thus certain precautionary measures can be taken. Migrant species are not present during all seasons but may be locally abundant near air bases or within flight lanes during specific months. Objective - to accurately depict the seasonal range of each of 20 species of gulls and terns common to the United States and to relate this information to the location of Air Force bases, to describe the monthly schedule and density of larid migration. Weekly analysis will be provided for air bases having a high potential for bird/aircraft problems, to ascertain the population density for gulls and terns in each region of the United States during each month, to determine the geographic origin of gulls responsible for hazards to aircraft at specific bases, to provide a quantitative basis for assessing hazards levels at various locations. How research contributes - this research will support research objectives contained in subarea 1.8, 'biological contributions to Air Force effectiveness'.

Band encounter data for gulls will be analyzed by a FORTRAN program that sorts data into any of 12 categories and plots encounter sites on overlay maps of North America. Information obtained from several sources will be used to prepare phenograms that can serve as an advance warning system for flight officers and/or pilots. Prior to flights it will be possible to recognize possible hazardous areas, to determine the extent of the risk, to select alternate routes if necessary, and to know the approximate duration of dangerous bird concentrations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0009, VULNERABILITY REDUCTION OF AIRCRAFT ENGINES

W.S. Thompson, U.S. Dept. of Defense, Army, Armament Research & Development Command, Vulnerability Lethality Div., *Aberdeen Proving Ground, Maryland* 21005 (DA0P4483)

Conduct tests and analyses to establish new evaluatory concepts for reduction of vulnerability in Army propulsion systems.

Monitor advanced technology demonstrator engine (T800) designs for maintenance of low vulnerability achievements - analyze and expand base of test data on current fleet systems using contract assistance -continue coordinating in development of USAF turbine engine compartment simulator for use in small engine compartment simulation tests.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Lab.

1.0010, AERODYNAMIC ANALYSIS OF AIRCRAFT FIRES

A. Moussa, Arthur D. Little Inc., *15 Acorn Park, Cambridge, Massachusetts* 02140 (DF144490; F33615-79-C-3420)

One of the major causes of combat aircraft loss is the ballistically induced fuel fire. Much data, both combat and experimental, indicates the importance of various aerodynamic parameters in evaluating the probability and severity of aircraft fires. The objective of this effort is to determine the effects of aerodynamic parameters on the initiation and perpetuation of aircraft fuel fires and to develop an analytical modeling technique that will enable the aircraft fuel fire phenomenon to be studied in existing test facilities. The data generated from these studies can then be used to define tactics and design techniques to prevent or extinguish aircraft fuel fires in a combat environment.

Evaluate existing test and combat data to determine effects of various aerodynamic parameters on aircraft fuel fires. Develop an analytical model that will accurately describe these effects. Perform a non-dimensional analysis leading to an accurate sub-scale modeling technique. A scale model will then be built and tested to demonstrate the feasibility of modeling these parameters and their effects on fire.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0011, KEVLAR PROPERTIES DETERMINATIONS

N.J. Abbott, Fabric Research Lab. Inc., *1000 Providence Hwy., Dedham, Massachusetts* 02026 (DF138070; F33615-78-C-3406)

Aerodynamic decelerators are required in the performance of many military missions such as aircraft landing decelerations, aircraft spin recovery, crew escape and recovery, weapons delivery and recovery of remotely piloted vehicles (RPVS). It is most desirable that the decelerator subsystem be as small as possible and as lightweight as practical to accomplish the objective for which it is designed. parachute systems previously fabricated from nylon materials can be reduced in both volume and weight by as much as 50 percent by utilizing kevlar materials. This program will determine the effects of static and dynamic loading, abrasion and cyclic loading on the properties of selected coated

and uncoated Kevlar ribbon parachute materials configurations and typical junctions. Reducing weight and volume of the decelerator or recovery subsystem minimizes the impact on the payload or range capabilities of the primary vehicle.

Kevlar material configurations (for which specifications have previously been developed) and typical junctions or joints in the materials will be subjected to laboratory tests to determine effects of abrasion, cyclic loading and impact loading. Where low resistance to abrasion or poor efficiency in materials is evident, efforts to effect improvements through application of coatings will be undertaken.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0012, COCKPIT DISPLAYS FOR NEW CONTROL CAPABILITIES

W.M. Hollister, Massachusetts Inst. of Technology, School of Engineering, Dept. of Aeronautics & Astronautics, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DF142110; AFOSR-78-3620)

This work unit will support the development of cockpit displays for control configured aircraft. These advanced aircraft will provide for new dimensions in guidance and control. The addition of direct lift and side force control provides the pilot with separate control capability over all six degrees of freedom. A problem exists with using a conventional flight command system which directs attitude changes to make flight path corrections. The objective of this effort is to perform the research required to define a new display format to obtain maximum utility from the new control capabilities. Advanced combat strategies are possible with the added control dimensions, but displays must be developed to present command information required for the pilot to fly the prescribed maneuvers in current and future military aircraft.

Conduct graduate thesis research on the development of cockpit displays to provide guidance for new control capabilities. Cockpit simulation facilities will be utilized. Results will be documented in graduate thesis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0013, FLIGHT TRAJECTORY CONTROL INVESTIGATION

M.W. Bird, Lear Siegler Inc., *4141 Eastern Ave., Grand Rapids, Michigan* 49508 (DF141380; F33615-78-C-3607)

The Air Force function for this effort is to study and develop advanced techniques for real time flight trajectory generation and execution of complex flight paths for advanced military transport aircraft. Future mission requirements and air traffic control constraints will present significant pilot workload and performance problems to flight crews if additional capability is not provided by enhanced flight control system features. The objective of this effort is to develop a set of algorithms suitable for on-board computation of complex trajectories which also interface with pilot displays to minimize crew duties. This development will provide the Air Force capability to operate in future civil and military environments not possible with current aircraft equipments.

Development of trajectory generation software. Software validation and capability demonstration via computer based engineering simulation. Definition of display requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0014, STOL ASSAULT TRANSPORT CREW COMPLEMENT STUDY

J.C. Wolf, Honeywell Inc., *2600 Ridgeway Pkwy. N.E., Minneapolis, Minnesota* 55413 (DF139620; F33615-77-C-3065)

The work performed will support the test and evaluation functions of af organizations involved in weapon system development. Crew station evaluation techniques will be developed and utilized in the determination of the total flightcrew complement required for the accomplishment of the tactical assault transport mission. This effort, will address the crew fatigue and aircraft operation and control aspects of the crew size/composition problem, as well as investigate/develop crew workload prediction methodologies. The baseline and experience required for the development of a methodology to achieve optimal crew systems configurations which are motivated by operational concepts will result from this effort.

Mission scenarios will be generated to include total crew duties and tasks associated with the transport mission. A mission script will be developed which considers all transport crew functions. Crew station assessment efforts, sensitive to crew workload, will be pursued utilizing physiological, psychological, and mission performance data. The crew performance will be evaluated in a real time operational theater.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0015, BODIES OF TRANSLATION

L. Mitschang, McDonnell Douglas Astronautics Co., *E. 411 St., St. Louis, Missouri* 63166 (DF737540; F30602-77-C-0233)

The objective of this program is to develop an analytical technology which will be used to characterize the electromagnetic behavior of structures having a constant cross-sectional geometry (similar to an aircraft wing, tail, or fin). The structures of interest are those composed of finite conducting material. They will have maximum dimensions of 20 wavelengths in length and 10 wavelengths in perimeter. This technology will be used to develop a computer program with the capability of modeling these structures. It will also calculate the near and far electric and magnetic fields radiated or scattered from them, as well as the current distribution.

A numerical technique will be developed which will model the desired structure and predict its electromagnetic behavior. This technique will then be developed into a user oriented computer code and implemented on the RADC computer. The computer code will be debugged and documented, provided in the form of a user's manual and a code documentation manual.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

1.0016, INTEGRATED AUTOMATIC FLIGHT/FIRE CONTROL SYSTEMS - FIREFLY II

R.P. Quinlivan, General Electric Co., *P.O. Box 5000, Binghamton, New York* 13902 (DF135960; F33615-75-C-3143)

This work unit directly supports the mission of all current and future tactical fighter aircraft - to accurately deliver weapons on target, and survive. Improved weapon delivery accuracy and increased survivability will result in reduced combat losses, lower operating cost, and overall increased combat effectiveness. The overall objective of this effort is to increase aircraft survivability and improve the delivery accuracy of conventional unguided air-to-air and air-to-surface weapons through the integration of the aircraft's flight control and fire control systems. This effort will establish the desirability of integrated flight control/fire control systems and will establish the technology base for future efforts.

A variety of applicable techniques and configurations for interfacing the flight control and fire control systems will be defined and analyzed for a selected tactical fighter aircraft. Advanced designs such as direct lift and direct side force will also be addressed. Comparative analysis of weapon delivery accuracy for the various automatic and manual systems will be included. Results of the analysis will be confirmed by a detailed piloted simulation effort which utilizes the flying qualities of each aircraft/flight control/fire control configuration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0017, NAVY VEHICLE DESIGN AND CONSTRUCTION - LIFTING SURFACE THEORY FOR THRUST AUGMENTING EJECTORS (ABBREV)

P.M. Bevilaqua, Rockwell International Corp., Columbus Aircraft Division, *4300 E. 5th Ave., Columbus, Ohio* 43216 (DN875520; N00014-78-C-0557)

The objective of this investigation is to develop a computational technique for thrust augmenting ejector analysis that will include the effects of conditions external to the ejector as well

as flow within the ejector shroud. For thrust augmenting ejectors in V/STOL aircraft applications, the influence of the aircraft wing/body, the proximity of the ground in landing and takeoff and the requirement for shorter, more compact diffuser sections all have an influence on augmentor performance. Classical ejector analysis considers only conditions internal to the ejector shroud and therefore cannot satisfactorily predict overall ejector performance when installed in a V/STOL configuration.

The approach taken in this effort is to separate the ejector flow field into two regions: the flow through the ejector and the flow external to the ejector. A viscous inner solution that accounts for upstream influence is matched to an inviscid outer solution including free stream velocity normal to the ejector axis.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

1.0018, INVESTIGATION OF AIR FORCE FIGHTER AIRCRAFT FLIGHT CONTROL SYSTEMS TO DETERMINE ACCURACY IN AIR-TO-GROUND WEAPON DELIVERY

J.J. Bankovskis, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF124850)

The contribution of the flight control system to the achievement of weapon system delivery accuracies will be investigated to determine significant interactions with the fire control systems. Specific aspects such as handling qualities, control system augmentation, pilot workload and display will be considered.

The program will involve three tasks: Task I - the study and evaluation of the provisional signal standard published by RTCA SC-117 and the total national program plans to assure satisfaction of USAF requirements. Task II - the study of all proposals for concept validation programs to assess the merits of each and provide technical inputs to the USAF validation program. Task III - the study and evaluation of low cost and alternate techniques to satisfy USAF tactical requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0019, AIRCRAFT/WEAPON SYSTEM OPTIMIZATION

R.L. Clark, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF140170)

The Air Force function for this effort is to study advanced weapons carriage/integration applicable to present and future air to ground attack weapon systems. Conventional external carriage can significantly degrade the performance of these aircraft while internal carriage can result in volumetric penalties. The objective of this effort is to develop prediction techniques and design criteria for external and internal carriage including advanced forms of external carriage such as conformal and tangent fuselage mounted stores. These approaches can minimize the performance degradation and installation problems associated with external carriage at transonic and supersonic speeds, and potentially improve weapon separations, expand delivery envelopes, and improve the aero-acoustic environment associated with internal weapons bays.

Experimental program will be initiated to acquire basic data on aircraft/store compatibility. These data will include aeroacoustic data in weapon bay cavities with and without suppression devices and isolated store force data. The aircraft/external store interference prediction technique generated under contract F33615-73-C-3018 will be computerized and evaluated using available experimental data. Technical problems lie in the complex interference flow conditions in the transonic speed range which force reliance on experimental data as the base for prediction method development.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0020, MILITARY AIRCRAFT VULNERABILITY TO ATMOSPHERIC ELECTRICITY

V.L. Mangold, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF132780)

Analytical and experimental efforts within the Air Force are needed to provide data for the protection of military aircraft to the effects of atmospheric electricity. This effort will establish technology for reducing the vulnerability of military aircraft to the natural environment associated with atmospheric electricity. The results of this program will have applications to commercial aircraft and space and ground vehicles.

This effort will establish facilities and a safe location for conducting experimental programs with lH2. These facilities will be used to provide a data base for development of criteria and technology for evaluating the S/V of the lH2 fuel systems to non-nuclear hostile threats.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0021, DEVELOPMENT OF THERMAL AND FLOW MEASUREMENT TECHNIQUES

D.M. Parobek, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF142430)

Advanced re-entry, interceptor, and maneuverable military flight vehicles operate at speeds which lead to problems with aerodynamic heating. This has generated the requirement to measure the surface heating rate to test models of these vehicles and certain thermodynamic parameters of the flow fields surrounding these vehicles. The objective of this work unit is to develop the instrumentation required to make these measurements.

Specialized measurement instrumentation will be developed in-house with contract assistance as required. Extensive tests on new sensors, probes, struts, and various other measurement instruments such as infrared detectors and scanners will be conducted in the thermal lab and test facilities. Work units 14260116, 14260120, 14260134, 14260135 and 14260213 are in process of termination and the remaining work of these will be consolidated under this new work unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0022, VISUAL SYSTEM MICROPROCESSOR DRIVE IMPLEMENTATION

J. Pollard, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF143790)

This effort is in support of the engineering R&D simulation mission of the engineering flight simulation facility (AFFDL/FGD). It addresses the method of controlling and driving the terrain model visual system resident at the facility. The objective is to design and implement a microprocessor based system for controlling and driving this system, with both hardware and software development anticipated. Fruition will result in the 'freeing' of a valuable general purpose computer for other applications, and help to establish in-house expertise in this area.

The approach involves a cooperative effort between AFFDL/FGD and USAFA/DFEE over approximately a one-year period. Most hardware and system software aspects will be handled by DFEE, while visual related software will be handled primarily by FGD. Cross involvement is of course expected and is to be encouraged for training reasons. A project schedule is currently under mutual formulation and review. The scheduling indicates parallel development of hardware and software portions with mutual feedback influencing latter portions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0023, AIRCRAFT EQUIPMENT VIBRATION TEST CRITERIA

R.W. Sevy, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF136640)

Aircraft equipment vibration test spectra, estimated by contemporary methods, are in many cases overly conservative in

amplitude and unrepresentative in spectral form. In addition, aircraft stores criteria do not adequately address effects of mass distribution and rack sensitivity. These deficiencies result in inadequate design, excessive costs and unrealistic labortory tests. To mitigate these penalties it is necessary in the case of equipment to develop a test criteria that can be tailored to the specific mounting method, the location and to the aircraft class and operational category, and in the case of stores to develop criteria which will satisfy mass distribution and rack requirements.

Realistic assessment of and prediction of actual environmental conditions that equipment is subjected to in field service will be determined through acquisition and analysis of aircraft environmental data. Realistic combined environment profiles will be developed for evaluation and test of aircraft equipment for various classes of aircraft. Capability to 'fly the equipment in the laboratory' will be developed by combined environment testing under realistic temperature, airflow, humidity, altitude, and random vibration conditions representative of aircraft equipment installations. New testing standards will be generated to provide the tests required to increase the effectiveness of testing needed to assure that only reliable hardware is introduced into service.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0024, A/C FUEL TANK WALL RESPONSES TO HYDRODYNAMIC PRESSURES

S.J. Bless, University of Dayton, Research Inst., *300 College Park Ave., Dayton, Ohio* 45469 (DF140810; F33615-77-C-2082)

Combat survivability is a factor in developing an effective weapon system. A major cause of combat losses is the high vulnerability of aircraft fuel systems to nonnuclear threats. Aircraft fuel cells are susceptible to catastrophic fracture and rupture due to the intense pressure pulses immediately following impact by a ballistic projectile. The objective of this effort is (1) to develop a thorough understanding of the phenomenon (hydrodynamic ram) that causes this catastrophic damage and (2) to develop design criteria for combat-aircraft fuel-cells which can be used to inhibit or negate this damage, thus minimizing the vulnerability of the fuel tanks.

An analytical and experimental program will be conducted with a thorough analysis of each significant event beginning with projectile impact and continued as long as the resulting pressure pulses are intense enough to cause fuel-tank-wall catastrophic rupture/fracture/failure. Existing computer models will then be reviewed and/or modified for assessment methodology. Finally, the computer models will be used to develop families of design curves and design criteria which can be used to design aircraft fuel-tanks to inhibit or negate catastrophic failures resulting from the hydrodynamic ram phenomenon.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0025, AIRFRAME STRUCTURAL MECHANICS

S.L. Huang, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN133126)

Evolve engineering hypotheses for use in determining residual strength, fracture resistance and crack growth behavior in structures as means of ensuring structural integrity of naval aircraft.

Develop and verify crack growth models suitable for automated application for prediction of safe life and residual strength of metallic aircraft structures. Utilize and refine newly developed finite element methods in the localized analysis of typical structural assemblies. Apply advanced analytical procedures to develop and numerically quantify new strength and failure theories for composites, and design and perform experiments to demonstrate the various phenomena. Fabricate and test representative composite structural specimens after exposure to various environmental effects and or subject to low velocity impact. Some of this work is being performed under contract, as reported in work units DG 602 B6, B9, B11, B12, B13, B14, B15, B16.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Systems Command, Tech Admin.

1.0026, DEVELOP AND IMPROVE ANALYTICAL TECHNIQUES OF MAJOR FINITE ELEMENT PROGRAM

H. Hanson, Bell Helicopter Textron, *Hwy. 183, P.O. Box 482, Fort Worth, Texas* 76101 (DA0E3845; DAAK51 78 C 0011)

To expand on the investigation of Vincent Circle Technique application on a complex helicopter finite element model to include damping and dynamic absorber location changes.

Apply the Vincent Circle Technique to optimize the vibratory response, at a selected point and under a specified load, on an elastic line model of AH-1G aircraft and conduct a sensitivity study using the strain energy method. Repeat the above process utilizing a complex 3-D AH-1G NASTRAN model. Also, the Vincent Circle Technique will be investigated further by damping and dynamic absorber location changes.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0027, SERVICE TRACKING AND EVALUATION OF S-3A GRAPHITE/EPOXY SPOILER

C. Foreman, Vought Corp., *P.O. Box 5907, Dallas, Texas* 75222 (DN781395; N62269-76-C-0439)

To closely monitor the usage and performance of composite structure on fleet aircraft in order to evaluate long term durability, reliability, and maintenance requirements of composite structure in the Navy operational environment. This work is in support of work unit ZA601, 'aircraft technology', agency accession no. DN 681080.

Fourteen ship sets of spoilers, fabricated under previous contracted efforts, will be installed on fleet aircraft. A handbook will be prepared for squadron and field service personnel containing inspection requirements, damage criteria, and repair and maintenance procedures. Program progress will be reported quarterly for the first year and semi-annually thereafter. Spoiler ship sets will be periodically removed and shipped to NAVAIRDEVCEN for non-destructive and destructive evaluation. Program duration is five years.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

1.0028, PHASE II, FLUIDIC BACK-UP FLIGHT CONTROLS, PNEUMATICALLY POWERED

W.C. Kuhnel, Vought Corp., *P.O. Box 5907, Dallas, Texas* 75222 (DN890214; N00019-79-C-0433)

Conduct a test and evaluation of a pneumatically powered single axis back-up flight control system to determine the capability of fluidics technology to meet the control requirements for level II/III flying qualities as specified in MIL-F-8785B for CTOL/V/STOL aircraft.

The approach to be taken in this project will be to conduct tests on a single axis bread board back-up flight control system to establish system performance for static and dynamic responses to pilot input command and to rotational rate. Tests will be run to evaluate the system's sensitivity to environmental effects, cross axis rate, translational acceleration, vibration, temperature and altitude variations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0029, EJECTOR WING DESIGNS

Unknown, Vought Corp., Aeronautics Division, *P.O. Box 5907, Dallas, Texas* 75222 (DF143740; F33615-79-C-3017)

The design of innovative aircraft is an important function of the Air Force. Deficiency in the present design methods is such that only certain refinements to the conventional configurations can be made in order to fulfill the mission requirements. The objective of this effort is to develop new designs such as an ejector-wing which provide significantly advantageous lift and thrust augmentations. This will provide the Air Force with aircraft that can be energy saving and maneuverable in the low flight speeds.

Ejector wing configurations will be developed by means of a compressible flow analysis so that optimized propulsive and

aerodynamic characteristics are achieved. On the basis of the theoretical data, a test model will be fabricated and tested in a wind tunnel for validating the concept.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0030, HT 78-40 - AUXILIARY ROTOR ENERGY CONCEPTS FOR AUTOROTATION
G.T. White, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0E3838)

Analytically explore auxiliary energy concepts to reduce helicopter main rotor RPM decay during autorotation.

Conduct a literature search for pertinent historical data. Compute, using the Sikorsky developed autorotation maneuver program (AMP), and catalog the autorotation capability of several helicopters with various disk loadings at selected points within the respective light envelopes (that is, define the miminum H-V diagrams). Select candidate methods or concepts of auxiliary rotor energy - analyze these concepts with the amp to define auxiliary energy contribution -determine efficacy of auxiliary energy concepts on various types and disk loading helicopters - estimate concept complexity, size and weight - simulate auxiliary energy concept effectiveness to reduce the baseline vehicles H-V envelope - and determine normal operational flight penalties.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0031, DEVELOPMENT OF AN IMPROVED GROUND VIBRATION TESTING AND ANALYSIS METHOD FOR COMPLEX AEROSPACE SYSTEMS
R.F. Michalak, Boeing Co., *7555 E. Marginal Way S., Seattle, Washington* 98124 (DF140030; F33615-77-C-3059)

Ground vibration tests on current and new weapons systems require an excessive amount of time and cost. The general objective of this program is to develop and demonstrate an optimal, practical, and economical ground vibration test and analysis procedure for use in complex aerospace systems to determine by measurement their dynamic characteristics. The procedure developed shall be one which can be used for testing a wide variety of Air Force flight vehicles in both laboratory and field environments. The dynamic characteristics shall be of sufficient quality and in acceptable form for use in checking analytically predicted data in final flutter and other aeroelastic analyses. The specific objectives of this program are to markedly decrease the time and cost for ground vibration test (GVT), and to obtain additional dynamic characteristic data from test information.

The program will be conducted by a contractor using a team with expertise in the flutter and structural dynamics fields. To accomplish the above objective, the program will be divided into phases consisting of method selection, development, demonstration, application and reporting.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, NITROPOLYETHER PREPOLYMERS FOR CAST PROPELLANTS AND EXPLOSIVES
D.L. Ross, S R I International, *333 Ravenswood Ave., Menlo Park, California* 94025 (DN975506; N00014-79-C-0525)

The objective is synthesize homo and copolymers of nitro substituted cyclic ethers. Nitrooxetanes and nitrotetrahydrofurans will be the first monomers to be synthesized. The hydroxyl terminated nitro polyethers will be useful to improve the density and specific impulse of cast propellants or to increase binder contents of propellants without sacrificing performance.

Synthesis routes to new cyclic ethers with nitro substitution at 3 positions on the oxetane ring will be explored. Similarly tetrahydrofurans with nitro substitution at the 3 and 3,4 positions will by synthesized. The resulting monomers will be homo and copolymerized using cationic polymerization techniques.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0002, A BIOLOGICAL WASTE WATER MONITOR STUDY USING DIFFERENTIAL LASER LIGHT SCATTERING FROM BACTERIA
P.J. Wyatt, Science Spectrum Inc., *1216 State St., Santa Barbara, California* 93105 (DF053030; F49620-78-C-0096)

AF function - the Air Force uses a variety of chemicals in its daily operations. These chemicals may provide detrimental impact to surrounding environments and/or be toxic to humans and other life forms. Recent legislation mandates that the Air Force assess the toxicity of the unique chemicals it uses and be responsible for assessing and controlling pollution in its operations. Deficiency - rapid and accurate methods for pollution monitoring and toxicological assessment are required to replace the time consuming and costly techniques presently employed. Objective - the objective of this research is to provide basic data necessary for the development of a rapid bioassay method for monitoring toxicants. How research contributes - this work should provide needed data on the applicability of bacteria as monitors of toxicants from any liquid effluent and contributes directly to subarea 1.9, 'environmental protection and toxicological hazards.'

The investigators will measure dose-response curves for several bacterial strains as a function of toxicant concentration. The toxicants studied will include missile propellants (hydrazines), jet fuels, nitrosodimethylamine and various phenolics of Air Force interest. Basic studies to quantitate the effect of the various toxicants on growth rates, morphologies, sizes and size distribution of bacterial cells will also be undertaken. Research to identify bacteria best suited for the detection of specific toxicants will be initiated. Effects on two component mixed cultures will be studied for at least two different toxicants. Application of results for the development of a rapid screening method for toxicants will be examined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0003, GROWTH OF LARGE SINGLE CRYSTALS OF GAN
W.A. Tiller, Stanford University, School of Engineering, Dept. of Materials Science & Engineering, *Stanford, California* 94305 (DN890057; N00019-79-C-0327)

The achievement of a device suitable for wide band-gap material such as GAN would open new opportunities for high temperature transistor-like devices and also blue-green LED's and lasers in military systems. As a research effort leading to the potential device exploitation of this material the primary objective of this effort will be to study in depth the existing information concerning the preparation and properties of GAN single crystals and to study the applicability of several new techniques toward the growth of large crystals.

The experimental study of the growth of single crystals of gan will employ both a horizontal and vertical temperature gradient system. Efforts will be made to control the vapor pressure of GAN in the gas phase so that seed crystals can be grown at higher temperatures without decomposition.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

3.0004, INFRARED CHEMILUMINESCENCE STUDIES OF ION-MOLECULE REACTIONS IN A FLOWING AFTERGLOW
S.R. Leone, University of Colorado, Boulder Campus, School of Arts & Sciences, Dept. of Chemistry, *1200 University Ave., Boulder, Colorado* 80302 (DF051780; AFOSR-78-3565)

AF function - Air Force operations in reconnaissance, communication, detection and discrimination require understanding of complex atomic, molecular and ionic chemical phenomena that take place in the natural and disturbed atmosphere. Deficiency - there is insufficient understanding of fundamental proc-

esses of ion-molecule reactions involving atmospheric constituents which can emit various forms of radiation. Objective - investigate the fundamentals of ion-molecule reactions by studying infrared chemiluminescence in a flowing afterglow apparatus. Obtain information on product state vibrational distribution occurring in ion-molecule reactions. In cases where reactions are highly exothermic and produce very highly excited vibrational states, obtain relaxation rates of such highly excited species and measure vibrational deactivation rates of molecular ions. How work contributes - provides a measure of ionic species formed in atmospheric reactions, radiation emitted from such species, and lifetimes and deactivation processes. Also, will have a bearing on emissions and lifetimes of species formed in rocket exhausts in atmosphere.

A flowing afterglow apparatus, incorporating mass and infrared detectors, will be constructed and will permit detailed wavelength and time dependent studies of ion molecule reactions which yield infrared chemiluminescence. A unique flow, reverse-drift region will be used to select only positive or negative ions for study with removal of neutral radicals. Specific systems to be studied involve many reactions of interest in the upper atmosphere and sources of atmospheric infrared emissions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0005, BASIC STUDIES RELATING TO THE SYNTHESIS OF UNSYMMETRICAL DIMETHYL HYDRAZINE AND MONOMETHYL HYDRAZINE BY CHLORAMINATION

H.H. Sisler, State University System of Florida, University of Florida, College of Liberal Arts & Sciences, Dept. of Chemistry, *208 Tigert Hall, Gainesville, Florida* 32601 (DF042070; AFOSR-76-2915)

AF function - substituted hydrazines are components of several presently used liquid rocket fuel mixtures. Monomethyl hydrazine (MMH) is a major component of the fuel for the proposed space shuttle. The principal use of unsymmetrical dimethyl hydrazine (UDMH) is in the Air Force Titan II and Titan III rocket. Deficiency - due to the carcinogen nature of the presently used starting material for making UDMH, there is a need for kinetic and mechanisms studies of alternate processes for making the fuel. Objective - this research is aimed at better understanding kinetics and mechanisms of the Sisler process for making UDMH and MMH. How work contributes - the information obtained will be exceedingly valuable in optimizing the manufacture of UDMH and MMH by the Sisler chloramination reaction.

The studies include investigations of the oxidation of monomethyl hydrazine (MMH) and unsymmetrical dimethyl hydrazine (UDMH) with oxygen, the thermal or hydrolytic conversion of dimethyltriazanium chloride of UDMH and the reactions of chloramine (CA) with monomethylamine (MMA), MMH, dimethylamine (DMA) and UDMH in various media including aqueous caustic solutions. The goal is to optimize the yield of UDMH and MMH by the chloramination of MMA and DMA.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, PRECIPITATION PROCESSES IN REFRACTORY METAL-INTERSTITIAL SYSTEMS USING ANALYTICAL ELECTRON MICROSCOPY

H.L. Fraser, University of Illinois, Urbana Champaign Campus, School of Engineering, Dept. of Mining Engineering & Metallurgy, *106 Engineering Hall, Urbana, Illinois* 61801 (DMR78-07761)

This is a study of phase transformations and precipitation processes that occur in refractory metal-interstitial systems, from the point of view of microchemistry and correlation of chemical changes with modifications in the morphology, microstructure, and crystal structure of the resultant precipitates. An important part of this program involves of necessity, development of appropriate analytical electron microscopy techniques. The alloys chosen for this study include the Nb-O, Nb-N and Nb-O-N systems, since they exhibit multistage precipitation processes. Since the pure metal is seldom used in high temperature environments and energy conversion systems, Nb-Ti-interstitial alloys will also be studied. The segregation of Ti will be determined, and the results obtained will be correlated to changes in the precipitation processes. In these studies, elemental analysis will be achieved through a combination of the complementary techniques of energy dispersive x-ray analysis and electron loss spectroscopy. Since application of the latter technique to light element analysis is relatively new, technique development is an important part of this research. It is expected the results of this research will contribute to an understanding of multistage precipitation processes in refractory metal-interstitial systems. This is the first year of a three year continuation grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0007, ENVIRONMENT-ASSISTED FAILURE OF FACE-CENTERED-CUBIC HIGH ALLOYS

N.F. Fiore, University of Notre Dame, School of Engineering, Dept. of Materials Science & Engineering, *Notre Dame, Indiana* 46556 (DMR78-07167)

This is a continuation of a fundamental investigation of the interaction between environment, metallurgical structure, and embrittlement in highly alloyed stainless steels (316 L and 20 Cb3) and Ni-base superalloys (alloy G and C-276). The alloys will range in structure from cold-worked to fine grained polycrystalline and single crystalline. Electrochemical hydrogen permeability measurements will define hydrogen mobility as a function of matrix composition and passive film behavior. Flow sorption studies will establish the extent to which aggressive ions absorb on the alloy surfaces, and to which inhibiting ions prevent adsorption and cracking. Electrochemical dissolution studies will establish the extent of selective ion dissolution present in the alloys. In all cases, environment-assisted-cracking (EAC) tendency will be established by time-to-failure and fracture mechanics testing. It is expected the results of this research will: (1) assess the validity of proposed EAC theories such as hydrogen embrittlement by decohesion, failure by stress-sorption, and selective-ion dissolution for these alloys; and (2) establish which metallurgical forms of these alloys show maximum resistance to EAC in standard H, Cl and S-bearing environments. This is a continuation of research, previously funded under NSF Grant DMR76-08901 A02.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0008, LONG-RANGE MOLECULES

W.C. Stwalley, University of Iowa, School of Liberal Arts, Dept. of Chemistry, *Jessup Hall, Iowa City, Iowa* 52240 (CHE77-14681 A02)

Dr. Stwalley will investigate long-range molecules, i.e., molecules (mainly diatomic) in their highest closely-spaced vibrational-rotational levels near dissociation. These molecules have unique and exotic properties which, however, are often simply related to the long-range behavior of the interaction potential (e.g. -C6R-6). The existence of such molecules has been conclusively established by electronic spectroscopy and independently by theoretical calculation. This research will involve spectroscopic studies (e.g. using a high-resolution tunable laser) principally of diatomic Li-containing molecules (e.g. the A 1 sigma plus u state of Li2 where nearly half the vibrational states is predicted to be long-range) with complementary theoretical studies as appropriate.

This research represents a continuation of that currently supported by Foundation grant CHE-74-13019.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0009, SYNTHESIS, EVALUATION, AND DEFECT COMPENSATION OF TETRAHEDRAL GLASSES AS POSSIBLE SOLAR CELL MATERIALS

R.D. Rauh, E I C Corp., *55 Chapel St., Newton, Massachusetts* 02158 (C-550; AC03-79ET23039)

The goal of this project is to evaluate the potential of the A/sup II/B/sup IV/C/sup V//sub 2/ tetrahedral glasses as solar cell materials. The chalcopyrite glasses have structural and electronic properties which allow their chemical modification for ideal photovoltaic characteristics. The research is directed towards four principal tasks: (1) synthesis and characterization of bulk quantities of A/sup II/B/sup IV/C/sup V//sub 2/ compounds; (2) production of amorphous thin films of these materials; (3) evaluation of optical and electrical properties of the amorphous materials; and (4) construction and testing of solar cells. The work will concentrate on the series CdMP2, CdMAs2, ZnMP2, and ZnMAs2, where M is Ge, Si, or Sn, since these materials are the least expensive and have the most promising band gaps.

SUPPORTED BY U.S. Dept. of Energy, San Francisco Operations Office

3.0010, INTERMOLECULAR FORCES AND MOLECULAR MOTION

R.G. Gordon, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Chemistry, *Cambridge Station, Cambridge, Massachusetts* 02138 (CHE80-15804)

This grant supports research under the Quantum Chemistry Program for theoretical studies of chemical dynamics. The project is directed toward three computational bottlenecks which hamper making satisfactory a priori predictions for most systems of general chemical interest. (a) Potential energy surfaces. A simple but quantitative, first principles model for covalent bonds will be developed. If it is successful, it could slash by orders of magnitude the computational effort required to generate these surfaces for typical cases. (b) Quantum scattering theory. Here the goal is to provide a theory which is practically applicable even when many quantum states can be reached by the collision, starting from one (or a few) initial states. This corresponds to a typical experimental situation with many modern techniques, such as selective laser excitation gases, and initial state-selected molecular beam scattering experiments. (c) Coupled kinetic equations. A new method will be developed for solving the time-dependent equations for systems of coupled reactions, such as occur in many areas of application, including atmospheric chemistry, combustion, industrial processes, enzyme kinetics, energy transfer in gases. The new method gives solutions for complex cases, even involving hundreds of reactions, more efficiently than do traditional methods.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0011, CALCULATION OF CERAMIC PHASE DIAGRAMS

L. Kaufman, Manlabs Inc., *21 Erie St., Cambridge, Massachusetts* 02138 (DF042880; F44620-76-C-0060)

AF function - ceramic materials are being developed for a variety of components (e.g. blades, vanes, rotors, combustors, bearings and seals) in future gas turbine engines and for a variety of electronic and optical components in aircraft. Opportunity - the process of selecting the chemical composition and heat treatment of any material to obtain optimum properties has been a slow one based upon past experience and time consuming experimentation. Over the past ten years computer techniques have been developed for calculating the phase diagrams of simple binary and selected ternary metal alloy systems. This offers the possibility of rapidly and economically searching out phase equilibria on any combination of metals desired. Objective - the calculational techniques developed for metal alloys will be extended into ceramic systems based on combinations of Cr, Al, Fe, Mg, Ca, Si, nitrogen, and oxygen. How work contributes - this work contributes to the selection of thermodynamically stable materials for future af turbine engines.

The lattice stability, compound and solution phase interaction parameters will be evaluated to characterize the stable and metastable phases in selected binary and ternary oxide/nitride combinations. thermochemical data will be estimated and evaluated from existing experimental phase diagrams where necessary. Additional work will address the thermodynamic considerations of the CVD doped germanium-borosilicate glasses appropriate to optical communication fibers.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0012, MATERIALS SUPPORT TECHNOLOGY - METASTABLE ALLOYS PRODUCED BY RAPID QUENCHING

B.C. Giessen, Northeastern University, School of Liberal Arts, Dept. of Chemistry, *360 Huntington Ave., Boston, Massachusetts* 02115 (DN675496; N00014-76-C-0820)

Amorphous metal alloys are an unexplored class of materials that offer unique electromagnetic and mechanical properties for Navy devices. The present task is aimed at characterizing the properties of a number of these alloys and improving the theoretical basis for understanding their formation.

The program approach has been redirected toward more in-depth studies of new metallic glasses. These are now: studies of aging behavior, including ordering, phase separation, glass property degradation and recrystallization; effect of oxygen content on properties; wear behavior; corrosion behavior; and high pressure effects. Extended metastable solid solutions, microcrystalline alloys and new metastable compounds will be studied.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0013, PHYSICAL METALLURGY STUDIES OF THE U-MO-NB-TI ALLOY

J. Greenspan, U.S. Dept. of Defense, Army, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center, *Watertown, Massachusetts* 02172 (DA0G4797)

It is the objective to characterize the process parameter - material property relationships of the subject alloy, including the reproducibility limits as feasible.

Ingots of the order of 100 pound size will be vacuum induction melted, cast, and heat treated using conventional techniques. Compositional homogeneity, microstructural characteristics, and mechanical properties of the ingot will be monitored. Ingots will be extruded to rod using conventional techniques, and the extruded rods will be heat treated and similarly monitored. Homogenized, solutionized, and aged conditions will be encompassed.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center

3.0014, ENERGY AND MOMENTUM EXCHANGE BETWEEN SOLIDS AND GASES

L.B. Thomas, University of Missouri, Columbia Campus, Graduate School, Dept. of Chemistry, *205 Jesse Hall, Columbia, Missouri* 65201 (DF042550; AFOSR-76-2934)

AF function - aerospace vehicles. Deficiency - lack of knowledge of interactions of gas molecules with solid surfaces. Objective - to complete additional measurements of clean-surface tangential momentum accommodation coefficients on magnetically suspended, spinning balls, and to analyze and prepare for publication a large body of data compiled from the previous work of the principal investigator on momentum and energy accommodation on surfaces of known cleanliness or known coverage with gas molecules. How work contributes - by making generally known the physical details of these interactions and the conditions governing them, it should be possible to make more accurate a priori predictions of aerodynamic forces as well as to be better able to design around gas contamination processes on spacecraft carrying optical and infrared or ultraviolet sensors or emitting devices.

A large body of raw data accumulated from previous measurements of thermal accommodation coefficients by the principal investigator will be corrected and prepared for publication using recently accomplished measurements of mercury pumping effect and temperature distribution on tungsten filaments. Some

additional data points will be taken to complete certain sets of data. Tangential accommodation coefficients will be measured by the magnetically suspended spinning disc method.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0015, PREPARATION AND STUDY OF HIGHLY REACTIVE METAL POWDERS 15255-C

R.D. Rieke, University of Nebraska, Lincoln Campus, School of Arts & Sciences, Dept. of Chemistry, *Lincoln, Nebraska* 68508 (DA0F9102; DAAG29-78-G-0007)

To determine the scope and limitations of a new technique for generating metal powders in a finely divided and highly reactive state; to establish the modes of reactivity. Relevance: Reactive metals are used in rocket propellants, in explosive and pyrotechnic formulations. Certain basic synthetic procedures have been accomplished in a direct fashion only since the discovery of the subject process.

Main group and transition metal salts will be reduced with molten potassium metal in inert solvents; the effect of crown ethers will be explored.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0016, CRACK PROPAGATION IN PRE-CRACKED SPECIMENS OF ALPHA, ALPHA-BETA AND BETA Ti-Mn ALLOYS

H. Margolin, Polytechnic Inst. of New York, Brooklyn Campus, School of Science & Engineering, Dept. of Metallurgy, *333 Jay St., Brooklyn, New York* 11201 (DF054100; AFOSR-79-0028)

AF function - the longevity, reliability and safety of aerospace structures are related to the fatigue properties of the structural materials used. In fact, the fatigue properties of structural materials often limit their application. Opportunity - thus, it is important to understand the mechanisms of fatigue and especially the metallurgical means by which fatigue resistance may be improved. Systematic studies of fatigue crack initiation and propagation in alpha-beta titanium alloys are of great interest to the Air Force and would make useful contribution to future development of engineering alloys. Objective -this research will determine the relationship between fatigue properties and microstructures of two-phase (alpha-beta) titanium alloys. Specifically, the Ti-Mn system will be used as a model system for alloys consisting of two ductile phases. How work contributes - alloy composition and heat treatment can be used to vary the volume fraction and morphology of the phases present, and thus, by this study, the most desired microstructures for fatigue resistance can be determined.

Fatigue crack initiation and propagation characteristics will be related to microstructural features such as phases present, particle size and distribution, and dislocation densities. Monotonic and cyclic stress-strain curves will be determined for each alloy composition to aid in interpretation of fatigue data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0017, THE MECHANISM OF FRETTING FATIGUE CRACK INITIATION IN MEDIUM STRENGTH STEELS 15979-MS

D.J. Duquette, Rensselaer Polytechnic Inst., School of Engineering, Dept. of Metallurgical Engineering, *110 8th St., Troy, New York* 12181 (DA0G8994; DAAG29-79-C-0013)

To perform systematic studies of the basic mechanisms of crack initiation in fretting-corrosion-fatigue. Relevance: Fretting and its extensions in fretting-corrosion-fatigue have been of serious consequence in engine and rotating sturctural components of Army aircraft. Such phenomena may also be responsible for some classes of problems in high-rate-of-fire weapons, and in ground vehicular components.

Experiments will be performed on a 4130 steel which develops a wide range of structures and properties upon heat treatment. Variables to be studied include differential hardness of faying surfaces, amplitude of slip, frequency, environment, temperature, and surface hardness.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0018, FATE OF SELECTED AIR FORCE PROPELLANTS AND LUBRICANT ADDITIVES IN THE AQUATIC ENVIRONMENT

H.C. Sikka, Syracuse Research Corp., *Merrill Ln., Univ. Heights, Syracuse, New York* 13210 (DF046860; F49620-77-C-0027)

AF function - a number of chemicals including missile propellants and lubricant additives are widely used in Air Force operations. These may be introduced into the aquatic environment through routine operations, spills, and waste-discharge effluents, and are of concern due to their potential toxicity. They may affect man through the drinking water supply, accumulate in the food chain, or be converted to other products with even greater toxicity. Deficiency - little information is available on the environmental fate of Air Force missile propellants and lubricant additives. Objective - this research will address the environmental fate of selected Air Force chemicals to evaluate the hazards associated with their release. The objective is to determine the rates and products of degradation of n-phenyl-l-naphthylamine and its uptake and metabolism in aquatic species. How research contributes - results of this study should provide information needed to establish guidelines regarding discharge of Air Force products into water systems subject to state and federal regulations. This research directly supports subarea 1.9, 'environmental protection and toxicological hazards' and RO 1.9.1, 'health effects'.

Oxidation and photodegradation of n-phenyl-1-naphthylamine (PNA) will be studied in non-acidic solutions. The oxidation products will be isolated and identified using chromatographic and spectroscopic methods. The toxicity, uptake and metabolism of PNA in aquatic organisms (bluegills, trout and daphnia) will be measured under both static and flow-through conditions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0019, ATOMIC AND MOLECULAR PROPERTIES AND THEIR RELATIONSHIP TO SEPARATION PROCESSES

W.L. Taylor, Monsanto Research Corp., Mound Laboratory, *P.O. Box 32, Miamisburg, Ohio* 45342

The objective of this research is to investigate the physical properties of isotopes and their mixtures. Currently, experiments are being conducted to measure the total scattering cross section, the thermal diffusion factor, the diffusion coefficient and vapor pressure of the permanent gases and their isotopes. The resulting data are analyzed to probe and ascertain fundamental atomic interactions and to provide information necessary for the design and operation of isotope separation systems. Total cross sections have recently been measured for the Ne-Ar system and are presently underway for He-Ar. A unique velocity selector is being tested which will reduce the energy spread of the molecular beams used in this work. Thermal diffusion factors have been measured for all noble gas isotopes and their binary mixtures. Ordinary diffusion coefficients have been measured for the majority of noble gas isotopes and mixtures, and experiments are continuing on the remaining systems. Vapor pressure work is concentrating on the hydrogen isotopes using ultrapure deuterium in the experiments. A new and improved interaction potential for helium atoms was recently determined and published as a result in part of the current work.

SUPPORTED BY U.S. Dept. of Energy, Office of Energy Research

3.0020, INTERDISCIPLINARY RESEARCH PROJECT ON SLIDING WEAR 15643-MS

D.A. Rigney, Ohio State University, Columbus Campus, School of Engineering, Dept. of Metallurgical Engineering, *190 N. Oval Dr., Columbus, Ohio* 43210 (DA0F9240; DAAG29-78-G-0138)

To study highly disturbed surface and subsurface regions of metals and alloys which undergo slidng wear. Relevance: The research has potential of application to armament components (e.g., gun tubes), and to a wide range of sliding contact elements used in helicopters, tanks, and other vehicles.

Specifically, the research will focus upon the formation of fragmented layers, their microstructure, texture, cellular structure, and the roll of parameters such as stacking fault energy upon cell formation during the wear process. An attempt will be made to relate shapes and sizes of wear debris particles to cell geometries, and solute enhancement in the surface region will be studied in terms of the diffusion and solubility of solutes with respect to cell walls. Both dry wear and wear under lubricated conditions using fatty acids will be studied.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0021, STRUCTURAL AND KINETIC PROPERTIES OF GRAPHITE INTERCALATION COMPOUNDS

D.L. Chung, Carnegie Mellon University, Graduate School, *Frew Ave. & Margaret Morrison, Pittsburgh, Pennsylvania* 15213 (DF051500; AFOSR-78-3536)

AF function - airborne systems utilized for command, control, communications, reconnaissance and surveillance depend heavily upon interconnected electronic components. Opportunity - increased efficiency of these systems can be expected from the use of less expensive lighter materials such as intercalated graphite compounds for electrical conductors. Intercalated graphite compounds, weighing about one fourth of that of copper, offer potential conductivities greater than that of copper. Objective - this research seeks better understanding of the basic physical properties of graphite intercalation compounds through studies of the microstructure and defect intercalate interaction, the kinetics of intercalate sorption and desorption, exfoliation, and intercalate absorption. How work contributes - this work should contribute to the development of graphite intercalation compounds that could replace copper as the dominant electrical conductor of airborne systems.

The structural and kinetic properties of graphite intercalation compounds are studied. Attention is given to the microstructure which varies with the parent graphite material, the intercalate species and concentration, the sample preparation technique, the interaction of the intercalate with structural defects, the epitaxial growth of the intercalate on the intercalated compound, the kinetics of intercalations, and the kinetics of exfoliation. The techniques and methods of electron microscopy (STEM, SEM), x-ray spectroscopy, electron and x-ray diffraction, thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC) and auger electron spectroscopy (AES) are used to investigate compounds prepared from various pristine graphite materials, including pyrolytic graphite, natural graphite flakes, isotropic graphite, grafoil and graphite fibers.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0022, FATIGUE IN POWDER METALLURGY ALUMINUM ALLOYS

A. Lawley, Drexel University, School of Engineering, Dept. of Metallurgical Engineering, *32nd & Chestnut Sts., Philadelphia, Pennsylvania* 19104 (DF047690; AFOSR-77-3247)

AF function - the longevity, reliability and safety of aerospace structures are related to the fatigue properties of the structural materials used. Opportunity - since the fatigue properties of structural materials often limit their application, it is important to understand the mechanism of fatigue and especially the metallurgical means by which fatigue resistance may be improved. Objective - this research will establish and quantify processing-microstructure-mechanical behavior relationships in fully-dense powder metallurgy materials. Particular interest centers on fatigue response in aluminum-base alloys and includes the roles of stress state and environment. How work contributes - since aluminum alloys form a major portion of the material currently used for skin and other structural airframe applications, it is appropriate that they are the basis of this investigation.

The fundamental understanding of the fatigue behavior of powder-metallurgy-processed aluminum alloys to be developed during the course of this research will provide the basis for carrying out future alloy and process development to achieve improved materials. In addition, the principles developed during the course of this investigation should also be applicable to other age-hardening systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0023, MECHANISMS OF EROSION 14084-MS

N.H. MacMillan, Pennsylvania State University, University Park Campus, School of Earth & Mineral Science, Dept. of Materials Science, *116 Deike Bldg., University Park, Pennsylvania* 16802 (DA0F8961; DAAG29-79-C-0104)

To study erosion of materials by particles at subsonic velocities (less than approximately 3 x 10(4) cm/sec) in an attempt to identify the individual contributions of crack propagation and intersection, of plastic deformation, of impacting particle breakup, of particle-to-target adherence and of target melting to the overall erosion of a representative variety of metals and nonmetals. The data would be used to make a first order estimate of the particular combinations of erosive environment and target characteristics leading to the onset and to the maximum detrimental effect of each identifiable mechanism of material removal. Relevance: The proposed research is relevant to a number of army problems with particle erosion in helicopter rotor and turbine compressor blades and should represent a step forward toward understanding of erosion of missile components, gun tubes, and munitions.

He would investigate the surface and sub-surface damage resulting when single crystalline and polycrystalline solids of widely differing melting points and elastic-plastic response are impacted from different directions by particles varying in size, shape, and frangibility, and moving with different velocities.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0024, OXIDATION STABILITY OF OILS

B.B. Baber, Southwest Research Inst., *8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Texas* 78228 (DA0P3630; DAAK70 78 C 0001)

Develop bench screening tests to determine new lubricant quality and potential performance in field application - also develop protable/mobile field oil-test kit to determine in-service condition of lubricants.

Modify the jet fuel thermal oxidation tester (JEFTOT) for lubricant screener testing - evaluate existing commercial field oil-test kits, and modify these concepts as required for army application.

SUPPORTED BY U.S. Dept. of Defense, Army, Mobility Equipment Research & Development Command

3.0025, COMBUSTION MODELING OF SOLID PROPELLANTS

M.W. Beckstead, Brigham Young University, School of Engineering Science & Technology, Dept. of Chemical Engineering, *B-166 A S B, Provo, Utah* 84601 (DF054900; AFOSR-79-0100)

AF function - nearly all future Air Force rocket propulsion systems will use solid propellants. Deficiency - current analytical and experimental techniques are inadequate for accurate prediction and assessment of the combustion characteristics of these propellants. Objective - the objective of this research is to advance knowledge in four areas needed to understand the combustion of solid rocket propellants. These areas include diffusion flame analysis, aluminum combustion effects in double base propellants, catalyst effects in composite propellants and distributed combustion effects on propellant response function calculations. How work contributes - the results of this work will provide information needed to improve current analytical and experimental tools for predicting propellant steady and nonsteady combustion behavior and rocket motor performance.

An oxygen-methane diffusion flame burner will be built and used to collect data to assess various assumptions currently employed in application of the Burke-Schumann flame analysis to solid propellant combustion. A version of the BDP model, modified to account for double base binders, will be extended to treat aluminized propellants by incorporating a model for aluminum agglomeration. The resulting combustion model will be evaluated by examining predicted effects on burn rate, exponent, temperature sensitivity and combustion response. A version of the BDP model, modified to treat the effects of catalysts, will be evaluated against data currently available on catalyst effects on propellant combustion behavior. An aluminum agglomeration model will also be coupled to an acoustic calculation to examine distributed combustion effects on propellant response characteristics by comparing predictions with T-burner data. A steady state model will also be evaluated in terms of its capability to predict propellant nonsteady response characteristics.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0026, SINGLY BRIDGED METAL METAL-HYDROGEN-BORON COMPLEXES

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Although a few singly bridged tetrahydroborate metal complexes have been reported, the entire range of metal-singly bridged tetrahydroborate complexes is virtually unexplored based on literature investigation. To investigate this relatively unknown area of chemistry would be valuable in that such a study could provide a basis for (1) establishing the nature of the monodentate M-H-B bond, (2) providing information on possible intermediates in metal-boride catalyst formation, and (3) providing compounds which have the potential of acting as selective reducing agents toward organic functional groups.

The primary thrust of the research will be the synthesis and characterization of singly bridged M-H-B complexes.

SYNTHESIS: We propose to synthesize complexes in which the singly bridged M-H-B linkage is possible by virtue of the nature of the B-H moiety or the phosphine ligand. Complexes would be formulated as LxMHBR3; L equals PPh3, PPh2Me; M equals Cu, Ag; HBR3 equals HB(C2H5)3, HB(isopropoxy)3, HBR3- and HBCl3-. An alternate source of singly bridged species would result from the use of polydentate ligands, e.g., PhP(CH2CH2PPh2)2 and 1,1,1-tris (diphenylphosphinomethyl)-ethane (P3) which would permit only a single M-H-B attachment to occur.

CHARACTERIZATION: We propose to establish the existence and nature of the M-H-B bond by physical and chemical means. Techniques amenable to the characterization study include IR and NMR spectroscopy, conductivity, osmometry, and neutron diffraction. These will enable evaluation to be made of (1) the covalency of the M-H-B bond, (2) the stability of the M-H-B bond with respect to formation of other possible bonding modes, (3) the magnitude of the phosphine dissociation process, and (4) bond lengths and angles.

This project summary contained formulas, drawings, tables or nonkeyable data which are not shown above.

SUPPORTED BY American Chemical Society

3.0027, SYNTHESIS AND PHYSICAL PROPERTIES OF TRANSPARENT ENGINEERING THERMOPLASTICS BLOCK COPOLYMERS 14072-C

J.E. McGrath, Virginia Polytechnic Inst. & State University, School of Arts & Sciences, Dept. of Chemistry, *Blacksburg, Virginia* 24061 (DA0E9199; DAAG29 76 G0312)

It is proposed to investigate ductile glassy-glassy and glassy-crystalline block copolymers. Specifically, poly (aryl ether) polycarbonate and poly (aryl ether) - poly (alkylene terephthalate) systems will be studied in detail. Relevance: These new block copolymers potentially will have excellent dynamic mechanical and high strain rate properties and resistance to solvents. They will be candidate materials for helicopter windshields and as thermoplastics for engineering materials requiring stringent performance characteristics.

The chemistry and structural features that control phase separation and morphology will be investigated through the variation of the bisphenol in the polycarbonate structure, the diol in the terephthalate, block lengths, and block regularity. The dynamic shear moduli over a wide range of temperatures and frequencies will be used in evaluating viscoelastic characteristics.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0028, ELECTRONICALLY EXCITED MOLECULAR OXYGEN

E.A. Ogryzlo, University of British Columbia, *2075 Wesbrook Pl., Vancouver, British Columbia, Canada* V6T 1W5 (DF054490; AFOSR-79-0088)

AF function - air force operations in surveillance and detection demand a more complete understanding of interfering atmospheric phenomena. Deficiency - there is a lack of understanding of fundamental atmospheric processes that result in airglow. Objective - the goal of this research is to understand the process of atomic oxygen recombination to excited molecular oxygen levels that radiate energy upon decay. How work contributes - excited states of oxygen are a source of atmospheric 'glow' in regions of overlap with our detection systems. Knowledge of the details of this process will enable discrimination as an interfering light source.

Three ungerade electronically excited states of oxygen will be studied. The excited states will be obtained from gas phase recombination and surface catalyzed recombination of oxygen atoms and mercury sensitization of molecular oxygen. Analysis of the recombination and radiative processes will be accomplished by detailed examination of photon counting, mass spectral and E.S.R. results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0029, NEW MATERIALS FOR ELECTROCHEMICAL CELLS

J.B. Goodenough, University of Oxford, *S. Parks Rd., Oxford, England, United Kingdom* (DF049570; AFOSR-77-3402)

AF function - propulsion and power generation systems for operational vehicles and devices rely on electrochemical power sources, such as batteries and fuel cells. Deficiency - need for solid electrolyte materials and for information on the preparation and characterization of ionic conducting materials. Objective - work will be directed to the improvement of solid electrolytes, and of mixed electronic/ionic conductors for use in electrochemical cells. How work contributes - results will yield a better understanding of the preparation and characterization of new ionic conductors, both electronic insulators for electrolytes and electronic conductors for battery cathodes, and display purposes.

Emphasis will be given to the determination of thermochemical, structural, electrochemical, and transport data on selected solids relevant to their potential use as battery cathodes, display cathodes, or solid electrolytes. Work will concentrate on full characterization of the insertion compounds to lithium which form cathodically from the oxides of molybdenum, vanadium and manganese. Electrochemical and standard thermodynamic functions will be measured for the reactions. Quantitative information on the mobility of the alkali-metal species in the parent oxide matrix will be obtained from pulsed NMR measurements. Design of new cathodic insertion systems with known skeleton and layer compounds that are good solid electrolytes will be initiated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, DYNAMICALLY AIMED FREE FLIGHT ROCKET (TMP109)

G. Batiuk, U.S. Dept. of Defense, Army, Missile Research & Development Command, Systems Simulation & Development Directorate, *Redstone Arsenal, Huntsville, Alabama* 35809 (DA0G2151)

To determine the potential accuracy of a multiple rocket system optimally designed for wind bias elimination by aim adjustment.

High aerodynamic stability is utilized, along with spin and mallaunch reduction techniques, to provide tight control about wind biased boost trajectory. The actual bias will be measured during the first and subsequent rounds of the ripple and continuously corrected by a dynamically aimed launcher controlled from the instrument used to observe the bias.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Systems Simulation & Development Directorate

4.0002, SOLAR ATMOSPHERIC DYNAMICS

S.T. Wu, University of Alabama in Huntsville, School of Science & Engineering, Dept. of Mechanical Engineering, *Huntsville, Alabama* 35807 (ATM77-22484)

This grant will support the study of the following two problems: (1) Dynamics of the Solar Magnetic Field: Namely, what are the role and basic mechanisms of the change of magnetic field in the solar atmosphere and flares? and (2) Dynamics of Transients: Namely, what are the fundamental physical processes governing the observed transient phenomena in the solar atmosphere and wind?

In achieving these objectives, emphasis will be placed on the study of macroscopic dynamics so that the results will provide rational bases for the interpretation of observations. In addition, supplemental examinations will be considered on the physical processes affecting macroscopic dynamics, such as, the interaction between radiation and fluid motions (radiative hydrodynamics) and the interactions between particles and fields (plasma physics).

The specific objective of this work is to understand solar flares and the broader area is to further our understanding of magnetized plasma in the astrophysical context.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

4.0003, AXIAL COMPRESSOR PERFORMANCE IMPROVEMENT

R. Dodge, Signal Co. Inc., AiResearch Manufacturing Company, *402 S. 36th St., Phoenix, Arizona* 85034 (DF463140; F33615-78-C-2073)

To perform a detailed design optimization of a single-stage axial compressor using improved three-dimensional computational techniques.

Using a transonic, three dimensional viscous aerodynamic analysis to optimize the surface static pressure distributions and to predict loss and secondary flow distributions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0004, OPTICAL PROPERTIES OF ATMOSPHERIC PARTICULATES 15520-GS

J.A. Reagan, University of Arizona, School of Engineering, Dept. of Electrical Engineering, *Tucson, Arizona* 85721 (DA0F9295; DAAG29-78-G-0195)

To obtain basic data characterizing the extinction and backscatter properties of atmospheric particulates in the troposphere for a variety of meteorological conditions in an arid environment. Relevance: The development of lidar techniques for remotely sensing aerosol and smoke composition and concentration is of great current interest to the Army in regard to the smoke program, and in regard to assessing the performance of optical systems in many military contexts.

To operate a LIDAR system in the slant path mode to obtain data necessary for modeling particulate influence on optical propagation through the atmosphere, and to supplement the LIDAR measurements with data from a tethered balloon meteorological and particulate sampling system, and with particulate information gleaned from inversion of multi-wavelength radiometer data.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0005, IR MINI-SCANNER MISSION EFFECTIVENESS INVESTIGATION

J.V. Weaver, Lockheed California Co., *Burbank, California* 91503 (DN081062; N62269-79-C-0348)

To establish, on a preliminary basis, the mission effectiveness of the infrared mini-scanner concept for air ASW application against current and projected threats. This work supports work unit ZU701, accession no. DN681083.

Formulate modifications to existing asw system analysis models to include infrared line scanning sencors. Generate preliminary operational performance data for a limited scope of aircraft type, tactical system configuration and mission scenarios. Generate preliminary concepts for the integration of the mini-scanner into P-3 and S-3 aircraft and estimate the associated recurring and non-recurring costs.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Sensors & Avionics Tech Directorate

4.0006, CALCULATIONS FOR TURBULENT FLOWS IN DUCTS

T. Cebeci, McDonnell Douglas Corp., *3855 Lakewood Blvd., Long Beach, California* 90808 (DN890141; N00019-78-C-0613)

Development of methods for the calculation of turbulent flows in ducts.

Analytical study.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0007, ADVANCED CRUISE MISSILE TRACKING STUDY

A. Fang, Technology Service Corp., *2811 Wilshire Blvd., Santa Monica, California* 90403 (DF931010; F30602-80-C-0005)

The objective of this effort is to enhance surveillance sensor tracking capabilities against advanced threats such as the cruise missile and stealth aircraft. This will be done by implementing sensor queuing, track continuance correlation, optimized waveform selection and adaptive sensor parameter tailoring which promote sustained tracking and high signal-to-clutter detection.

Surveillance optimization techniques will be developed and assessed based on waveform adaptation which employs signal-to-clutter optimizatoin criteria, as well as, sensor queuing based on track continuance within a multi-sensor surveillance approach. The two threat models (Dedicated and Raid) will test the performance of the conceived techniques against low backscatter returns and evasive, low altitude flight profiles.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0008, IONOSPHERIC MODEL FOR ELF PROPAGATION

W.F. Moler, U.S. Dept. of Defense, Navy, Naval Ocean Systems Center, Environmental Sciences Dept., *San Diego, California* 92152 (DN888508)

Develop methods for improving ELF radio communications prediction for a nuclear warfare environment. Evaluate the accuracy of the prediction methods and make applications of the methods for hypothetical nuclear environments to aid in system planning.

Computational techniques use the earth-ionosphere waveguide mode model. Methods are developed for calculating propagation between electrical or magnetic antennas at any height or orientation within or above the waveguide and for treating propagation in nuclear disturbed waveguides. Prediction verifi-

cation uses both the transmissions from the WTF-ELF transmitter and from the 'slow tails' of sterics signatures.

SUPPORTED BY U.S. Dept. of Defense, Navy

4.0009, COMMUNICATIONS VECTOR ELECTRIC FIELD MEASUREMENTS ON BALLOONS AND SATELLITES

F.S. Mozer, University of California, Berkeley Campus, Space Sciences Lab., *3 Leuschner Observatory, Berkeley, California* 94704 (DN724005; N00014-75-C-0294)

The precipitation of energetic particles into the ionosphere causes degradation and disruption of naval communications, surveillance, and navigation systems including scintillation of satellite signals, fading and absorption of HF, ELF, and VLF signals, and auroral clutter on JF, VHF, and UHF radars. The effects are greatest both in magnitude and geographical extent during geomagnetic disturbances. The purpose of this research is to develop the better understanding of the mechanisms responsible for particle acceleration, for particle precipitation, and triggering of geomagnetic storms required to provide deterministic forecasts of propagation disturbances.

In situ measurements of AC and DC electric and magnetic fields, plasma density irregularities, and plasma density and temperature are taken by the onr 104 experiment on the high altitude polar orbiting satellite S3-3. These data are analyzed to determine the cause of auroral particle acceleration, field aligned currents, EXB motions, and the causes of ionospheric irregularities.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0010, DESIGN AND IMPLEMENTATION OF MULTI-INPUT ADAPTIVE SIGNAL EXTRACTORS

W.A. Gardner, University of California, Davis Campus, School of Engineering, Dept. of Electrical Engineering, *Davis, California* 95616 (DF055250; F49620-79-C-0086)

AF function - digital signal processing for such applications as radar, telemetry, and communications. Deficiency - increasingly stringent requirements in communications, reconnaissance, and flight control among others, create corresponding demands in the area of signal processing. The high costs in size weight and power have to be reduced, while speed and accuracy of the processors have to be improved. Objective - improvements in signal extraction performance, in the cost of implementation, and speed of operation of digital filters. How work contributes - the results of this research could be directly usable in the design of future Air Force electronics equipment.

The concepts of adaptive noise cancellation will be generalized to the area of adaptive signal extraction. The method depends on having two or more filter stages with appropriate feedback and variable or adaptive gains. Residue arithmetic will be exploited for speed and accuracy.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0011, MULTIMODE OPTICAL SWITCHING AND BEAM EXPANSION

E. Garmire, University of Southern California, School of Engineering, Dept. of Electrical Engineering, *3551 University Ave., Los Angeles, California* 90007 (DF903760; F19628-77-C-0221)

AF function - command and control. Deficiency/opportunity -communications links lack security and are inefficient. Objective - to develop integrated optic laser source optimally suited for coupling to optical fiber. How research contributes - provides improved source for optical communication links.

Integrated optics will be used to render the output of a CW GaAs double-heterostructure, stripe-geometry laser compatible with coupling to optical fibers. A distributed Bragg reflector will be used to achieve spectrally narrow output. A 100 micrometer-square beam will be produced by waveguide beam-expansion techniques for butt-coupling to a multimode optical fiber. First, the beam will be expanded in the plane of the waveguide by using a 90-degree grating beam expander. A grating output coupler will be used to produce a laser output normal to the waveguide surface having the desired near-field spot size and pattern. The effects of blazing the gratings on output coupling will be studied. Applications of waveguide beam expansion to optical signal processing will also be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0012, 27TH CONFERENCE OF THE HEAT TRANSFER AND FLUID MECHANICS INSTITUTE

M. Gerstein, University of Southern California, School of Engineering, Dept. of Mechanical Engineering, *3551 University Ave., Los Angeles, California* 90007 (DN075331; N00014-80-G-0078)

This program, giving partial support to the 27th Conference of the Heat Transfer and Fluid Mechanics Institute has the objective of providing interaction between research groups in the fields of combustion, propulsion, and ballistics and Defense Department groups concerned with utilization of the technology in aircraft, missile and armament applications. As part of the energy utilization project, the effort supports all projects under the energy. conversion subelement, particularly the tasks on energy release, aircraft and missile propulsion, and marine propulsion.

Under the joint sponsorship of ONR, OSR, NASA, and a group of universities, the 27th Conference on Heat Transfer and Fluid Mechanics will be held at the University of Southern California.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0013, KINETIC RATE CONSTANTS OF IMPORTANCE TO KRF AND ARF RARE-GAS-HALOGEN LASERS

G.J. Collins, Colorado State University, School of Engineering, Dept. of Electrical Engineering, *Fort Collins, Colorado* 80523 (ENG77-21625)

This research concerns a novel technique to measure excited state reaction rates of importance to the argon fluoride and krypton fluoride lasers. The novel technique involves measuring the radiative lifetimes of the upper laser levels of both ArF and KrF molecules and determine several collisional quenching rates. These quenching cross sections are of crucial importance to an understanding of high pressure electron beam and TEA discharge excited ArF and KrF lasers where the possible products of reaction, as well as the rates, are presently unknown.

Finally, having measured the rate constants, the He-Ar-RF and He-Kr-RF discharges which are employed in practical TEA, ArF and KrF lasers will be investigated to identify the major excitation mechanisms, the role of helium and determine if the excitation mechanism differs from the simple Kr-RF and Ar-RF mixtures.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0014, UNSTEADY VORTEX ENTRAPMENT ON AN AIRFOIL

J.E. Keesee, U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab., *Air Force Academy, Colorado Springs, Colorado* 80840 (DF282300)

AF function - technology base, counter air, close air support. Deficiency - flight vehicles currently designed in accordance with steady flow aerodynamic characteristics do not utilize potential performance capabilities available from dynamic stall and similar unsteady separation effects. How research contributes - this effort evaluates the formation, persistence and overall influence of energetic vortices produced by unsteady airfoil motions. The work ties to and is an extension of current research by FJSRL investigators in unsteady separation. Objectives - the research seeks to determine the feasibility of trapping a vortex generator by unsteady motions near the surface of an airfoil. An assessment of the correlation of airfoil motion, vortex intensity motion and stability, and the resultant surface loading will subsequently be made. Additionally, an analytical model will be developed to describe the results. This will lead to an improved understanding of the role of the various physical mechanisms on

the flow field and suggest possible improvements in flight vehicle design and maneuvering techniques.

A NACA 0012 airfoil immersed in a subsonic wind tunnel flow will be oscillated in two degrees of freedom using a microcomputer drive providing for both pitching motion and axial translation. Transient and oscillatory motions will be analyzed. Flow field parameters will be measured using a multicomponent laser doppler velocimeter and surface pressure transducers together with a minicomputer data acquisition system. A collateral analytical effort will be directed at generating a model describing the flow field.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab.

4.0015, EVALUATION AND DEVELOPMENT OF CONSTITUTIVE RELATIONS FOR INELASTIC BEHAVIOR

J. Eftis, George Washington University, School of Engineering & Applied Sciences, Dept. of Civil Mechanical & Environmental Engineering, *725 23rd St. N.W., Washington, District of Columbia* 20037 (DF058260; AFOSR-80-0096)

AF function - aerospace vehicles. Deficiency - present methods available for analytic and computational description of structural material behavior, particularly under severe operating conditions of vital interest, are seriously inadequate and significantly impact aerospace vehicle frame and engine performance, durability and cost. Objective - to be able to accurately, quickly and economically describe the structural behavior of materials. How work contributes - provides, as the first stages in an integrated research program, for a careful and thorough review, synthesis and critical assessment of the current state of technology in the field of solid material constitutive theory development, with an eye toward identifying both existing gaps in knowledge and those areas which provide the greatest potential Air Force relevant payoff.

A study will be made of the non-linear maximum entropy method of spectral analysis. In particular, the method will be implemented on a small computer. For this purpose, the existing algorithm will be modified to meet the constraints of smaller memory capacity and shorter word length. The algorithm will be developed to improve its convergence. Optimal choice of algorithm parameters and the extension of the method to more than two channels of data will be considered. Applications will be made to real data, such as, from seismic and geomagnetic detectors.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0016, WAVEGUIDE COUPLERS

W.K. Burns, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980231)

To assist in the development of improved techniques for coupling laser sources to waveguides and to characterize light propagation into these guides. Techniques will be investigated to improve coupling of diode lasers into waveguides. Butt coupling techniques will be studied initially with later studies to include an assessment of the viability of grating couplers. The propagation characteristics of the coupled light will also be investigated with emphasis on scattered light reduction.

Experimental and analytical studies will address problems associated with coupling diode lasers to waveguides. Output beam patterns will be measured for both waveguides and lasers and coupling efficiencies will be maximized by tailoring these profiles. Coupling via waveguide gratings will be investigated analytically to define problem areas and to project coupling efficiencies. The characteristics of light propagating in the waveguides will be determined and techniques to suppress scattered light will be developed.

SUPPORTED BY U.S. Dept. of Defense, Navy

4.0017, PHYSICS OF THE NEAR-SPACE ENVIRONMENT

R.R. Meier, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN320170)

To understand and describe the space environment near earth and how it is affected by the passage of missiles and disruptive effects which may arise from artificial and natural causes. To develop techniques of observing or following such behavior through theoretical analysis. To apply the knowledge gained for the use of new/existing military systems in the areas of early warning attack assessment, midcourse maneuvers, reentry and defense intelligence.

To achieve the above, we envision (a) development of theoretical models of missile signatures which describe their observability above the natural background in UV, (b) analysis of STP 72-1, SOLRAD HI and OSO-8 and satellite data to learn the natural UV background, and (c) refinement of radiation models of the space environment.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0018, RADIATION HARDENING OF POWER SYSTEMS

R.L. Statler, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980059)

The objective is to develop the technology for improved, hardened primary power systems for remote military applications such as earth-orbiting satellites and strategic and tactical applications relating to surveillance, communication, and weapon systems. The near term objectives are to compare technical advantages and limitations of state-of-the-art non-fossil fuel power sources, such as radioisotope thermal generators, thermal electric and photovoltaic. The hardness of these energy sources will be assessed for particle and gamma radiation environments.

Comparative parametric studies of various state-of-the-art power sources will be made in connection with specific operating environments, including space and terrestrial. Limitations in the adaptation or utilization of power source options will be determined. Data from unattended prolonged operation will be analyzed. Radiation hardness of power source materials will be investigated by analysis and experimental investigation.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0019, MAGNETIC SURFACE WAVE RESEARCH

D. Webb, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN880054)

The near-millimeter wave (100-1000 GHz) spectral region is receiving increased attention by the Navy because of its potential for achieving high resolution and all-weather performance simultaneously. however, because of the small electromagnetic wavelength many conventional approaches to components and circuitry are not practical. The objective of this program is to develop novel approaches, especially for receiver oriented technology, which circumvent these limitations.

Novel negative resistance mechanisms, e.g. cyclotron resonance in semiconductors with non-parobolic conduction bands, will be investigated for producing near-millimeter RF energy. Kinch-Rollin, Josephson Junction and Super-Schottkey detectors and associated circuitry will be studied with the goal of realizing an integrated cryogenic receiver.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0020, ADVANCED TRANSONIC COOLED LOW LEAKAGE TURBINE VANES

W. Mitchell, United Technologies Corp., Pratt & Whitney Aircraft Group, *P.O. Box 2691, West Palm Beach, Florida* 33402 (DF459750; F33615-78-C-2059)

Reduce turbine maintenance material costs while producing a turbine vane with enhanced performance.

Develop an improved turbine vane design methodology and apply it to the design, fabrication, and test of an advanced cooled turbine vane operating in the transonic flow regime.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0021, UTILIZATION OF AN EFFICIENT NUMERICAL METHOD FOR VISCOUS FLOW PROBLEM SOLUTIONS 16674-E

J.C. Wu, Georgia Inst. of Technology, School of Aerospace Engineering, *Atlanta, Georgia* 30332 (DA0G0896; DAAG29-80-C-0015)

To transfer some of the new knowledge and new techniques developed for the integral-representation approach for the numerical solution of complex general viscous flow to interested scientists in selected Army research laboratories. Relevance: The computational techniques being transferred are directly applicable to aerodynamics of helicopter rotors and missiles.

Workshops on the utilization of the integral-representation approach for viscous flows will be scheduled at the Aeromechanics Lab, RTL (AVRADCOM), and MICOM. Two sections separated by approximately one month, consisting of three half-day sessions, will consist of short lectures followed by discussions and hands on programming experience. A user-oriented code (SAMPATH code) will be provided for external unsteady incompressible flow. Agenda details will be finalized in accordance with the wishes of the participating laboratories.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0022, NAVY VEHICLE DESIGN AND CONSTRUCTION - UNSTEADY VISCOUS FLOW OVER THREE-DIMENSIONAL WINGS

J.F. Nash, Sybucon Inc., *Atlanta, Georgia* 30339 (DN875376; N00014-78-C-0351)

The performance boundaries of modern fighter aircraft extend well into the range of nonlinear aerodynamics associated with high angle-of-attack. Flow separation and vortex flow formation on wings are typical in these conditions. A significant amount of research has been done in recent years to develop computational methods to describe these types of flows. However, little has been done to include unsteady effects which can be very important for maneuvering aircraft. It is the objective of this research study to initiate the incorporation of unsteady effects in an approximate manner into viscous flow computations for flow over three-dimensional wings.

A coupled viscous boundary-layer/potential outer flow methods based on extended unsteady boundary-layer theory will be adopted. A time dependent turbulent boundary-layer method successfully developed for two-dimensional flows will be extended to approximate 3-D solutions and coupled to a full 3-D potential flow method. This approach will be used to investigate and describe the early phase of flow reversal and leading edge vortex formation on swept wings at high angle-of-attack.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0023, COMPUTER SIMULATION OF KINETIC PROPERTIES OF PLASMAS

J. Denavit, Northwestern University, Evanston Campus, Technological Inst., Dept. of Mechanical Engineering & Astronautical Science, *633 Clark St., Evanston, Illinois* 60201 (DN223216; N00014-75-C-0473)

Develop theory and numerical methods for plasma simulation and related problems in ionospheric and magnetospheric phenomena of interest to the Navy for application to communication systems via the ionosphere. Study very-low-frequency (VLF) emissions from the magnetosphere including the evolution of whistler sideband instability and whistler wavepackets, and the stability of field-reversed ion rings.

Theory and computational methods are developed for simulation studies of the evolution of whistler sideband instability under magnetospheric conditions. This includes extending the nonlinear evolution of whistler wavepackets in a nonuniform external magnetic field to the case of a whistler wave spectrum. Computer studies are also conducted on the stability of field reversed ion ring equilibria confining finite pressure plasmas.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0024, ENERGY CONVERSION - STAGNATION REGION GAS FILM COOLING FOR TURBINE COOLING APPLICATIONS

B.A. Reese, Purdue University, School of Aeronautics & Astronautics, *Life Sciences Bldg., West Lafayette, Indiana* 47907 (DN475466; N00014-75-C-0873)

The objective is to obtain accurate data on the local rate of convective heat transfer to a highly cooled surface exposed to an accelerated, highly turbulent hot gas flow, with particular emphasis on the influence of turbulence scale and intensity and unsteady effects on stagnation region film cooling. The effort is primarily experimental, with analytical modeling backup, and is aimed at optimizing engine performance while utilizing higher turbine inlet temperatures with necessary cooling schemes. The research contributes to increasing the performance of aircraft and marine gas turbine engines.

A two-dimensional rectangular flow channel, with heated air from a gas turbine combustor supplied to a cylindrical film cooled test surface is used to model the turbine vane leading edge. Test equipment has been modified to permit study of stagnation region film cooling using multiple rows of coolant holes. The cylindrical test surface has been scaled up, with a larger heat transfer surface to permit heat flux gauge installation between holes and rows of holes.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0025, AERODYNAMICS OF ADVANCED AXIAL-FLOW TURBOMACHINERY

G.K. Serovy, Iowa State University of Science & Technology, School of Engineering, Dept. of Mechanical Engineering, *496 Town Engineering Bldg., Ames, Iowa* 50011 (DF053730; F49620-79-C-0002)

AF function - advanced turbomachinery. Opportunity - improve understanding of flowthrough an axial flow turbojet engine. Objective -obtain a better understanding of the fluid flow physics related to multistage, axial flow turbomachinery. How work contributes - a better understanding of the fluid flow will improve our ability to produce competent turbomachine configuration designs.

A well coordinated analytical and experimental program has been established. The analytical program will involve investigation of the computational limitations and development problems in various approaches to three-dimensional, time dependent and real fluid extensions of current modeling procedures. The concurrent experimental program will explore the problems associated with acquisition, reduction and presentation of data to support future design/analysis methods.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0026, PLASMA MS EVALUATION

V. Fassel, U.S. Dept. of Energy, Ames Lab., *Ames, Iowa* 50010 (D9-X0147-1; KC61 -000118)

This project will evaluate the feasibility of coupling the plasma source of Tasks 115 and 116 to a mass spectrometer. The plasma is expected to provide a steady and abundant supply of atomic ions, increasing the precision and sensitivity of detection by the mass spectrometer and permitting direct analysis of aqueous solutions.

The plasma source has been attached to the quadrupole mass spectrometer. Ions created by the plasma source have been detected by the mass spectrometer. Development of a more efficient extraction of ions from the source region is now underway.

After construction and thorough testing, the instrumentation will be delivered to EPA.

PROGRESS: The instrument has been developed and shows very good analytical capabilities such as, linear calibration curves, low parts per billion detection, and rapid sample throughput.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Research Lab.

4.0027, FLUID DYNAMICS
G.M. Mattingly, U.S. Dept. of Commerce, National Bureau of Standards, Center for Mechanical Engineering, *Rte. 270, Gaithersburg, Maryland* 20234 (73208)

OBJECTIVE: Maintain, advance, and where necessary develop flow measurement standards in clean fluids such as water, air, and hydrocarbons that will produce a halving of the systematic errors found in interlaboratory flow metering tests by 1984. Provide technology, support services, and flow meter development which will enable U.S. industry to measure, within 5 years, fluid flow rate of intractable or hazardous fluids with accuracies or factors of two better than at present under actual, hostile conditions.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards, Center for Mechanical Engineering

4.0028, ACOUSTO-OPTIC SIGNAL PROCESSING
N. Berg, U.S. Dept. of Defense, Army, Electronics Research & Development Command, Harry Diamond Lab., *2800 Powder Mill Rd., Adelphi, Maryland* 20783 (DA0F5595)

To investigate the transient effects of x-ray pulses and the permanent effects of gamma-ray and neutron irradiation on surface acoustic wave (SAW) devices. To build a real-time convolver having a time-bandwidth product of 10,000 (interaction time of 40US and and 250 MHz bandwidth).

The transient radiation effects studies at the HDL high intensity flash x-ray (HIFX) facility require measurement of small transient changes of RF signal amplitude or of phase during and immediately after the x-ray pulse. For the permanent damage studies, device characteristics are measured both before and after each exposure. The convolver will utilize the interaction in a six inch long wafer of LiNb0 sub3 of a sheet laser beam with a surface acoustic wave. A long acoustic bandwidth will be achieved by using three sets of interdigital saw transducers in parallel.

SUPPORTED BY U.S. Dept. of Defense, Electronics Research & Development Command, Harry Diamond Lab.

4.0029, DIAMOND MACHINED LENS
R. Mergerian, Westinghouse Electric Corp., Defense & Electronic Systems Center, *P.O. Box 746, Balt-Wash Internat. Airport, Baltimore, Maryland* 21203 (DN980055)

To demonstrate the fabrication of corrected geodesic lens in ti-indiffused waveguides using numericaly controlled diamond machining techniques. Accurate control of the focal point, profile and position of these lens will be demonstrated. These lens will be corrected for spherical aberrations using a suitable lens profile. Single and double lens combinations will be fabricated and evaluated. Characterization will include thruput loss, scatter, focal length, diffraction limited performance and acceptance angle. The lenses will be designed for incorporation into microoptical microwave spectrum analyzers jointly under Navy and Air Force development.

Using computer, numerical controlled diamond machining techniques, several microoptical lenses will be fabricated. The profile of the lens has been theoretically determined and it allows for corrections for spherical aberrations. Edge rounding is accounted for in the program. Depth control of plus/-1 micron and placement of the focal point to better than 10 microns will be demonstrated. Using end-fire coupling techniques, the quality of lens will be examined thru far field measurements. Finally, a two lens optical system will be fabricated on a substrate whose edges were precisely polished. Final characterization of the lens will be performed using the Westinghouse photodiode array butt-coupled to the waveguide/lens system.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0030, QUATERNARY HETEROJUNCTION PHOTOTRANSISTORS AT 1.3 MICRONS
C.G. Fonstad, Massachusetts Inst. of Technology, School of Engineering, Dept. of Electrical Engineering & Computer Science, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (ECS79-14179)

A research program to study and fabricate quaternary heterojunction bipolar phototransistors for use as photodectors in optical fiber communication systems at 1.3 microns is being conducted. The basic issues that are being addressed are the control of doping and compositional interdiffusion at the heterojunction, sources of junction leakage, and the modelling and characterization of bipolar heterojunction phototransistors. These issues are important to any device applications of heterojunctions.

It is anticipated that these devices can be used in opto-electronic structures as well as microwave transistors and in very large scale integrated (VLSI) digital circuits.

This action renews the support of research on NSF Grant ECS76-09586.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Electrical Computer & Systems Engineering

4.0031, ROLE OF COUPLING AGENTS ON METAL-POLYMER ADHESION 16355-MS
N.H. Sung, Massachusetts Inst. of Technology, School of Engineering, Dept. of Mechanical Engineering, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DA0G9155)

To study the role of silane-type coupling agents on the promotion of adhesion and wet strength in polymer-metal joints. Relevance: The research is relevant to composite technology, and bonded joint technology for army helicopters, protective masks, chemical and biological defense items, and encapsulation of electronic devices.

Characterization of the substrate/coupling agent and coupling agent/polymer adhesive interfaces using Fourier transform infrared spectroscopy and ESCA. Mechanical testing of bond strengths using peel tests. Failure analysis of failed joints.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0032, RELATIONSHIP OF ABLATIVE MECHANISMS TO FIBER PERFORMANCE AGAINST LASERS
J. Caldarella, U.S. Dept. of Defense, Army, Natick Research & Development Command, *Natick, Massachusetts* 01760 (DA0J4216)

The objective of this effort is to determine the mechanisms of ablation and other breakdown patchways when fibrous polymers and other materials of potential value in individual protection are exposed to infrared CW laser radiation.

Selected polymeric materials will be exposed to controlled laser irradiation at 10.6 microns and other wavelengths of interest. Deliniation of breakdown processes will be sought by examination of volatile condensible materials and residues with and without positive removal of ablative material.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

4.0033, A MEASUREMENT OF THE METRIC ANGULAR DIAMETER-REDSHIFT RELATION FOR GALAXIES
D.J. Hegyi, University of Michigan, Ann Arbor Campus, Graduate School, *Rackham Bldg., Ann Arbor, Michigan* 48104 (DF057610; AFOSR-80-0095)

AF function - detection and surveillance of spacecraft. Deficiency - images fainter than about one percent of the ambient background are difficult to detect using vidicons, image intensifiers or photographic techniques. Objective - to measure the angular diameter of faint extended astronomical objects by using a charge-coupled device to perform picture processing in real time at the telescope. Contribution - this research on the angular diameter of galaxies will develop techniques to extract the maximum amount of information from a faint image and to detect images in a low contrast situation.

Observations of the angular diameter of galaxies will be carried out with a charge-coupled device, a minicomputer and a microprocessor. The observing plan has three phases. The first ten brightest elliptical galaxies in nearby clusters will be ob-

served to establish the surface brightness distribution to high accuracy. Similar data will be obtained at moderate redshifts in order to learn whether evolutionary effects within a cluster are significant. The observations then will be carried out to the greatest distance from which redshifts can be obtained.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0034, STUDIES OF THE ELECTRODE REGIONS OF HIGH INTENSITY ARCS

E. Pfender, University of Minnesota, Minneapolis Campus, School of Engineering, Dept. of Mechanical Engineering, *105 Morrill Hall, Minneapolis, Minnesota* 55455 (CPE80-08950)

The research is concerned with analytical and experimental studies of the electrode regions of high intensity arcs. Studies of the anode region are continued with emphasis on higher current levels and augmented by analytical investigations of the cathode region. Transport properties are calculated which are a prerequisite for modeling of the electrode regions. In these calculations, contaminations of the plasma by electrode materials and other additives are taken into account as well as non-equilibrium effects. Analytical models for the anode region are further improved and checked with corresponding experiments, especially with spectrometric and flow measurements. The models are applied to the cathode region to establish a unified theory for the electrode regions of high intensity arcs. A new anode theory is extended to two-dimensional situations to make it applicable to extremely constricted anode arc roots or spots. In parallel, experiments are done to confirm the predictions of this analysis. The diagnostic method for measuring local anode heat fluxes are applied to the measurement of anode heat flux distributions in pulsed arcs with currents up to ten kilo-amperes. The effects of anode melting and/or evaporation on the anode heat flux distribution are assessed. The research is a continuation of research done under NSF Grant CPE-7704108. Provision is made to support the research for three years.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Chemical & Process Engineering

4.0035, FRESNEL LENS AND BEAM CONTROL IN OPTICAL WAVEGUIDES

W.S. Chang, Washington University, School of Engineering & Applied Science, Dept. of Electrical Engineering, *4559 Scott Ave., St. Louis, Missouri* 63130 (DF055880; F49620-79-C-0145)

AF function - advanced Air Force weapon systems require the real-time processing of data obtained from a multitude of sensors at data rates which exceed current capabilities. This requirement necessitates the development of analog parallel processing techniques such as optical or acousto-optical processing. Opportunity - an integrated optical format must be found before such processing can be realizable onboard aircraft and missiles. Objective - this research will use Fresnel diffraction in an attempt to fabricate efficient and inexpensive waveguide lenses for integrated optical systems. How work contributes -the effort advances optical processors for avionics and command/control systems.

Fresnel lenses in high index of refraction waveguides such as lithium niobate will be analyzed, designed, fabricated, and experimentally evaluated. New phase reconstruction methods and volume holographic techniques will be investigated for their capability to improve Fresnel lens performance in such respects as side lobe reduction, better efficiency, and larger signal to noise ratios. Microfabrication techniques will be studied in an attempt to discover batch fabrication methods for the lenses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0036, COOPERATIVE PROJECT IN FRACTURE MECHANICS

P.C. Paris, Washington University, School of Engineering & Applied Science, Dept. of Mechanics, *4559 Scott Ave., St. Louis, Missouri* 63130 (INT77-15792)

This award to Washington Universtiy makes it possible for Dr. Paul C. Paris to carry out his 'Cooperative Project in Fracture Mechanics.' He will cooperate with Dr. Jose A. Vazquez of the Institute of Naval Technology of the Argentine Navy.

The project in fracture mechanics will concentrate on fatigue crack closure and on elastic-plastic stability criteria. Analytical models will be developed to explain the results observed on crack closure. Ultrasensitive instrumentation will be developed to obtain test data to evaluate critically the results of the models. This work has many applications such as in life prediction of aircraft structures. Also, stability criteria will be formulated for various elastic-plastic crack configurations and situations. Experiments will be done to test the criteria suggested by the analysis. Background data on materials for the critical experiments such as J-integral R-curve properties will be produced.

A joint seminar will be held in the U.S. to share results with other investigators. Each country will support the costs of its own participants.

SUPPORTED BY U.S. National Science Foundation, Directorate for Scientific Technological & Internat. Affairs, Div. of International Programs

4.0037, ADHESION AND PHYSICS OF ICE

D. Itagaki, U.S. Dept. of Defense, Army, Corps of Engineers, Cold Regions Research & Engineering Lab., *P.O. Box 282, Hanover, New Hampshire* 03755 (DA0D8151)

To provide fundamental knowledge of the mechanisms and properties of ice adhering to surfaces of fixed and rotary-wing surfaces as well as other surfaces where the accretion and adhesion of ice interferes with the operation of materiel. To establish basic principles involved in the development of methods and techniques to remove ice from surfaces. To explore and develop means to prevent and/or alleviate icing. To evaluate and predict incidence and intensity of icing on the basis of readily available meteorological parameters.

The required information will be generated by a coordinated sequence of investigations including microscale evaluation of the physics and properties of ice adhering to interfaces, examination of the mechanisms of crack propagation in ice near an interface, and investigation of the interrelationships and influences of electrical properties on the mechanical properties of ice. Studies will also be pursued to determine in more detail the actual mechanism of accretion with attention centered on the freezing process of small droplets from the time they first impact to the time when they are frozen (accreted) or removed by the ambient air stream. Information developed will be disseminated to users and other project participants to provide a basis for improved design and performance of materiel. Foreign state-of-the-art is being considered.

SUPPORTED BY U.S. Dept. of Defense, Corps of Engineers, Cold Regions Research & Engineering Lab.

4.0038, EFFECTS OF RADIATION ON THE ELECTRICAL PROPERTIES OF INSULATOR MATERIALS IN MOS DEVICES

G.W. Hughes, RCA Corp., David Sarnoff Research Center, *Washington Rd., Princeton, New Jersey* 08540 (DA0F5733; DAAG39-77-C-0159)

To investigate the nature of charge traps in SiO2 films (both dry and wet thermally grown) employed as the gate insulator in MOS devices as a function of changes in processing variables.

Charges generated by vacuum ultraviolet radiation and subsequently trapped near the gate and semiconductor interfaces will be studied both via tunnel injection currents induced by the trapped charge and by conventional C-V techniques.

SUPPORTED BY U.S. Dept. of Defense, Electronics Research & Development Command, Harry Diamond Lab.

4.0039, NEAR FIELD ANTENNA MEASUREMENTS
R. Staples, U.S. Dept. of Defense, Navy, Naval Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN096115)

Develop advanced test algorithms to provide both boresight and radiation pattern testing for installed airborne antennas with fault location capability for distorted patterns.

Develop an antenna test algorithms for use in a general purpose near field antenna tester. In addition, develop a simulated model antenna fault identification location tester. System feasibility studies will be completed with particular attention to requirements for built-in test.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0040, ANALYTICAL TRANSONIC FLOW
L. Sirovich, Applied Science Research Associates Inc., *37 Riverside Dr., New York, New York* 10023 (DN623024; N00014-77-C-0359)

The determination of theoretical methods for the accurate prediction of the flows about high speed bodies is essential for the design of missiles and aircraft. This research is directed to the development of a very fundamental understanding of the steady and unsteady flow fields about bodies at transonic and supersonic flight.

A major effort is being directed to the analytical study of transonic and supersonic flows to complement the many ongoing numerical and experimental programs. Particular emphasis will be devoted to the study of the structure of the flow field within the framework of the Navier-Stokes equations and within the framework of higher order approximate equations, both viscous and inviscid. The direction of the research will be to exploit analysis as much as possible to develop a deeper understanding of the flow, as well as to leading to improved numerical procedures for attacking such flows.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0041, AERODYNAMIC PROBLEMS OF LARGE SCALE COOLING DEVICES
F.K. Moore, Cornell University, Ithaca Campus, School of Engineering, Dept. of Mechanical & Aerospace Engineering, *242 Carpenter Hall, Ithaca, New York* 14853 (CME79-26404)

This research concerns heat exchangers, their integration into overall flow fields such as in a dry cooling tower, and their limitations due to fouling. Flows oblique to heat exchangers are studied analytically and by wind tunnel model tests. Means to control flow directions developed. Buoyant flows produced in natural - draft cooling towers are subject to disruption by 'cold inflow' at the top, a phenomenon dominated by transverse mixing by turbulence; turbulent mixing is also crucial in limiting the potential disruption by transverse nonuniformity of buoyancy of such flows. Analysis and wind tunnel techniques will be used to study these effects. Consideration is also given to the change in heat-exchange technology if 'fouling' were not a design consideration.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Civil & Mechanical Engineering

4.0042, CARS INVESTIGATIONS IN TURBULENT, SOOTING FLAMES.
M. Lapp, General Electric Co., Research & Development Center, *1 River Rd., Schenectady, New York* 12305 (DN975437; N00014-79-C-0381)

The objective of this research effort is to provide a scientific basis for a non-perturbing, space and time resolved optical probe of gas temperature and constituency in combustion systems, based upon laser raman scattering. Such optical sensors will be useful initially for provising detailed access to temperature and species concentrations in combustor flows as well as to possibly providing signals for control purposes - all necessary for improved propulsion systems for naval aircraft and missile applications.

Techniques developed during the past several contract years, will be utilized to measure flame product gas density from vibrational Raman scattering Stokes Q-branch signals, and temperature from the corresponding Stokes/anti-Stokes ratio of the nitrogen axial velocities will be measured by use of laser velocimetry apparatus. A pulsed dye laser source operating in the mid-visible will be used for the raman effort, in conjunction with spectrometer/photomultiplier or other advanced forms of detection.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0043, RESEARCH ON MICROWAVE JUNCTION-GATE FIELD EFFECT TRANSISTORS 13586-EL
S.K. Ghandhi, Rensselaer Polytechnic Inst., School of Engineering, Dept. of Electrical Engineering, *110 8th St., Troy, New York* 12181 (DA0E9120; DAAG29 76 G0172)

To investigate and improve junction field effect transistors in III-V compounds. Relevance - electronic III-V compound devices permit operation into tens of gigahertz - junction gate field effect transistors are expected to be more reliable than presently used Schottky gate field effect transistors. Vital relevance to communication/navigation satellites, tactical communication links, missile guidance, EW equipment.

To study basic problems associated with the growth and characterization of the channel layer, and with obtaining an improved understanding of diffusion and masking problems associated with the junction gate.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0044, DEVELOPMENT OF HIGH G AUGMENTATION DEVICES
G.J. Kron, Singer Co., *Binghamton, New York* 13902 (DF228250; F33615-77-C-0055)

To design prototype high-g augmentation devices to enhance the g-cue environment of future simulators. The devices will load the pilot's limbs, head and shoulders to augment the simulation of high-g effects.

The approach is to award a 9 month study contract for the design of g-cuing devices. Prototype devices (hardware and software) will be designed to apply appropriate forces effectively and safely. The contractor will investigate such techniques and devices as straps, active shoulder harness, active helmet, lower and upper body negative pressure, and a sound system for aural cuing. After these devices have been designed a separate contract for building the devices will be awarded.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

4.0045, ANTENNA RESEARCH
C.J. Drane, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF904550)

AF function - communication and surveillance. Deficiency - antennas that are rendered ineffective for practical applications by their great expense, immobility, high drag coefficient, susceptibility to jamming, high sidelobe levels, low gain, and narrowbandedness. Objective - to provide fundamental technical basis for antennas that are cost-effective with more precisely predictable sidelobes; have high gain and easy pertability; are low profile with minimal aerodynamic drag; have wide angular scan capability; are significantly less vulnerable to enemy jamming; have sidelobes that can be selectively reduced; can operate in a dual frequency basis. How research contributes - provides antenna technology for OTH backscatter detection radars, emergency communications, high performance aircraft, aircraft-to-satellite communications, tactical surveillance, radiation defense of ground-based radar and communications systems, and broadband communications capability.

Judicious loading of array elements to significantly mitigate interelement mutual coupling; perturbative and iterative adjustment of dipole lengths and spacings along a transmission line whose characteristic and terminating impedances are also pa-

rameters in maximizing the gain; investigation of radiation mechanisms, basic element properties and bandwidth of microstrip antenna arrays, surface wave concepts combined with phased array principles for high gain and efficiency over wide angles. Integrated design of reflector and offset feed for very low sidelobes; spatial filtering screens in immediate foreground of antenna arrays for selective reduction of sidelobes; short-backfire antenna structure combined with concentric loop for dual frequency operation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0046, ADVANCED DEVICE PROCESSING TECHNIQUES

A. Golubovic, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF902780)

AF function - communications and reconnaissance. Deficiency/opportunity - solid state components are too expensive. Objective - research new device processing techniques that improve the control and tolerance attainable in solid state device fabrication. How research contributes - solid state devices that are fabricated with processes that require reduced tolerance margins can be made cheaper due to increased yield and/or increased functional complexity per chip.

Electron, ion and laser beams will be investigated to obtain improvements in the achievable tolerances in lateral dimensions, doping, and doping profile respectively. Platinum-silicide Schottky barrier technology will be investigated in detail to determine the optimum reaction parameters for IR detectors and MESFET structures. Passivating dielectrics for INP will be sought.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0047, GAS CORRELATION FOR CARBON MONOXIDE

L.W. Chaney, U.S. Environmental Protection Agency, *Research Triangle Park, North Carolina* 27709 (DF336440)

To evaluate the capability of gas correlation spectroscopy for the remote (non-contact) sensing of carbon monoxide. Presently available point monitoring sensors have proven unreliable or inappropriate for determining the contribution of airfield operations to local environmental quality. A remote system would provide an integrated pollutant load.

Joint funding with EPA. Two existing systems will be evaluated by an independent party to determine their sensitivity, specificity, accuracy and reliability, and to recommend improvements.

SUPPORTED BY U.S. Dept. of Defense, Engineering & Services Center, Engineering & Services Lab.

4.0048, EFFECT OF BODY FORCE ON THE MOTION AND HEAT TRANSFER OF CONFINED FLUIDS

S. Ostrach, Case Western Reserve University, School of Engineering, Dept. of Mechanical & Aerospace Engineering, *University Cir., Cleveland, Ohio* 44106 (DF046540; F49620-79-C-0033)

AF function - advanced aerospace vehicles. Opportunity - improve our knowledge of coupled driving forces. Objective - to increase our understanding and useful data on natural convention transfer phenomena generated by coupled driving forces. How work contributes - this work is building a step by step understanding of coupled driving forces which are present in areas like fluids storage and reentry aerodynamics of nose cones.

Experiments will be performed on natural convention transfer phenomena due to multiple heat flow directions, combined temperature and concentration gradients to include gradients which are vertical but opposing and gradients which are horizontal and both augment and oppose one another, and the interaction of the thermal instability with the hydrodynamic instability.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0049, FLUID AND MECHANICAL POWER TECHNOLOGY DEMONSTRATION

K.E. Binns, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF458380)

To demonstrate new technology for potential aircraft users. Specific technology to be demonstrated will be 30,000 RPM vane pump, oscilating spool power transfer units, electrohydraulic digital actuators and emergency back up fuel pump system for F-16 aircraft.

Prototype hardware delivered as result of AFAPL R&D contracts will be installed in laboratory systems and demonstrated to potential users. Tests of a 30,000 RPM vane pump will be conducted to verify its performance for use in future A/C hydraulic systems. Inhouse concepts will be pursued.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0050, TURBINE ENGINE INTEGRATION ANALYSIS PROCEDURES

E.G. Blevins, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF452670)

To generate the propulsion system (inlet, engine, exhaust) performance trends and establish the engineering techniques necessary for improving delivered thrust-fuel flow characteristics during engine part-power operation.

Generate time-phased analysis and test techniques that forecast elemental propulsion system performance to defined levels of accuracy. Identify critical tests that must occur to define exhaust system -engine performance intereffects. Identify engine and exhaust system internal changes that are necessary to maximize delivered thrust at low throttle ratios.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0051, FIBER OPTIC SYSTEM EVALUATION LABORATORY

E.N. Humphreys, U.S. Dept. of Defense, Air Force, Avionics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF094640)

To supply the Air Force with information and data on fiber optic data transfer components and subsystems and to provide an inhouse capability to analyze, test, and verify the feasibility of selected aspects of optoelectronic technology.

A selected range of internal data transfer requirements for aerospace vehicles will be addressed under this effort. This includes-(1) multiplexed fiber optic data buses, (2) multiplexed fiber optic point-to-point systems and (3) dedicated point-to-point (both analog and digital) fiber optic systems. This effort will (a) design, fabricate and test electro-optical data transfer links, (b) develop and test various approaches to fiber optic terminations, handling and repair, (c) investigate input/output devices for the electro-optical data links in order to achieve system optimization, (d) develop dynamic analyzer test programs for testing optical and electro-optical components and systems in a simulated operational environment and (e) evaluate components, model and validate systems, and test and evaluate prototypes to provide a data base for system component selections for future aerospace vehicles. An inhouse lab will be established to measure and test components and subsystems. New data will be gathered and data from other sources will be verified. By gaining expertise in the area, recommendations can be made to branch and division on use of fiber optics technology in other system development programs. The lab will be capable of measuring light sources, photo detectors and optical fibers, both as components and in systems. Data signals will be analyzed before transmission over a fiber optic link and then afterwards to evaluate bit error rate for various configurations. Other tests will be performed to establish lifetime of components, survivability of components and systems subjected to vibration and temp extremes and the reliability of systems that have been assembled from component parts.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0052, AERODYNAMIC TECHNOLOGY ANALYSIS METHODS

D.E. Shereda, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF144710)

The efficient design of advanced high speed flight vehicles requires the early determination of their aerodynamic characteristics with reasonable levels of accuracy. Experimental testing programs are expensive and somewhat limited in scope. Analytical methods are inexpensive but are accurate only within narrow limits of the assumptions made in the development. This effort seeks to expand these limits for high speed aircraft and missile configurations through the evaluation, modification and development of analytical techniques. This will result in greater analytical capability for independent assessments and impact T&E resource utilization.

Recently developed analysis methods will be exercised, evaluated and improved for accuracy and ease of application. Comparisons of test data on advanced configurations with the latest analysis methods will provide insight into their short comings. New methods will be developed in the areas of unsatisfactory correlations with flight and test data. the effort will be primarily analytical relying on experimental data obtained in other programs.

SUPPORTED BY U.S. Dept. of Defense, Air Force

4.0053, DYNAMICS OF STRUCTURAL CHAIN SYSTEMS

R.L. Huston, University of Cincinnati, School of Engineering, Dept. of Engineering Analysis, *101 Baldwin Hall, Cincinnati, Ohio* 45221 (DN323083; N00014-76-C-0139)

The technical objective of the proposed work is to research and develop a systematic, computer-oriented method for obtaining and solving equations of motion of general chain structural systems of naval interest such as cables, chains, antennas, long flexible booms and aircraft-occupant dynamics. The dynamic equations of motion for such systems are highly non-linear due to the large geometric effects and the structural interactions.

Mechanical systems (e.g. human-body models, cables, beams, head/neck muscles and vertebrae, antennas, etc.) are modeled by a series of rigid bodies connected by springs and/or dampers and/or ball-and-socket joints. Computer algorithms are written to generate the coefficients of the governing dynamical equations of motion. Numerical results are then compared with experimental data. The approach is general in that it is three-dimensional, allows for finite displacement, and the connecting springs and dampers may be arbitrarily specified.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0054, OPTICAL DATA PROCESSING

D. Casasent, Carnegie Mellon University, Carnegie Inst. of Technology, Dept. of Electrical Engineering, *Frew Ave. & Margaret Morrison, Pittsburgh, Pennsylvania* 15213 (DF041370; AFOSR-79-0091)

AF function - advanced terminal guidance processors will permit maneuverable reentry vehicles to take evasive action while ensuring accuracy of delivery. Opportunity - the fundamental difficulty in achieving a practical terminal guidance system lies in real time correlation of the stored reference image with an input image that differs in scale, aspect, contrast and even content when sensed in a different spectral band or at a different time than the reference image. The most promising technology is optical processing with its increasing repertoire of space-variant data processing operations. Objective - the proposed research will investigate the problems associated with differences between input and reference imagery in missile guidance, and will devise appropriate optical pattern recognition techniques and systems to overcome these problems.

The following projects will be pursued - evaluation of optical pattern recognition techniques using the image test set from DARPA terminal guidance program, formulation of novel techniques for obtaining superb accuracy in the location of the correlation peak, investigation of optical processing of infrared and multi-sensor imagery, implementation of optical pattern recognition employing the feature vector space obtained from up to the third order central moments, and an assessment of detectors for optical processing.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0055, ANALYSIS OF CRITICAL MICROSCOPIC FLOW BEHAVIOR

J.L. Swedlow, Carnegie Mellon University, Carnegie Inst. of Technology, Dept. of Mechanical Engineering, *Frew Ave. & Margaret Morrison, Pittsburgh, Pennsylvania* 15213 (DF051080; AFOSR-78-3533)

AF function - improve durability of aerospace vehicles. Opportunity - to merge the materials science qualitative description of microscale constituent interactions with the solid mechanics quantitative description of mid and macroscale design parameters, via theoretical/computational research. Objective - to continue development of understanding of strain localization, void nucleation, growth and coalescence and transition to macrofracture in a multiphase/multiconstituent material. How work contributes - by providing a fundamental join of two well developed technologies, leading to improved understanding of the fundamentals of material/structure interaction, strength/toughness tradeoffs and the failure initiation process.

The previously developed computer progran (REF AFOSR-76-2993) will be appropriately modified to allow investigation of alternate criteria for inclusion-matrix debonding in order to determine debond location and stress level. These results will be correlated with metallurgical literature to establish model validity. With the initiation process model established, void growth, interaction and coalescence will be studied, with bond the single inclusion and multiple inclusion models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0056, SIGNIFICANCE OF LARGE SCATTER OF COMPOSITE PROPERTIES TO RELIABILITY OF AIRCRAFT STRUCTURES

P.C. Chou, Drexel University, School of Engineering, Dept. of Mechanical Engineering, *32nd & Chestnut Sts., Philadelphia, Pennsylvania* 19104 (DN981096; N62269-78-C-0267)

(1) To assess the adequacy of current structural design practices based on experience with metallic structural materials to structures constructed of advanced composite materials, (2) develop guidelines for future design criteria and structural validation testing to insure the adequacy of composite aircraft structures. This contract supports work unit DG 602, agency accession no. DN 133126.

A statistical parametric study will be conducted for a hypothetical fleet of aircraft using typical composite strength properties. Certain critically flawed structural locations will be assumed to exist in each aircraft and different series parallel arrangements of these flaws will be considered. The number of aircraft failures will be calculated for different confidence levels.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

4.0057, INTERFACE HARDWARE DESIGN CONSTRUCTION AND MAINTENANCE

R. Trapani, Trapani Engineering Inc., *Berwyn, Pennsylvania* 19312 (DN081318; N62269-79-C-0059)

To design and construct various items of interface hardware for the basic configuration no. 1 laboratory effort. To provide maintenance support for various items of interface hardware.

To procure from the original manufacturer of several GFE interface hardware the services and material necessary to perform above objective.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Communication Navigation Tech Directorate

4.0058, ULTRAFINE-GRAINED SUPERCONDUCTORS
A.I. Braginski, Westinghouse Electric Corp., *3 Gateway Ctr., Pittsburgh, Pennsylvania* 15222 (DF038430; F49620-78-C-0031)

AF function - high temperature superconducting materials are needed for application in airborne multimegawatt power generation and conditioning systems. Opportunity - research specifically directed toward the synthesis and characterization of high transition temperature metallic compounds can provide a greater margin of design efficiency and operational reliability than presently available superconductors. Objective - this research explores the feasibility of enhancing the superconducting and mechanical properties of high critical temperature superconductors through the preparation and characterization of materials with ultrafine-grained microstructures. How work contributes -the use of superconductors in airborne multimegawatt power generation and conditioning systems is desirable because of their ability to carry much larger current densities than conventional conductors and with lower losses. Hence very high magnetic fields can be generated with smaller, lighter windings. For many potential applications, the performance of high field magnets and solenoids, electric motor windings, superconducting rotors in power generators, transformers and induction energy storage systems could be significantly improved if the upper critical field, the current-carrying capacity and the critical transition temperature of the superconducting material could be enhanced.

The Bl and Al5 films with controlled, ultrafine grained microstructures will be formed by sputtering and also CVD. Attention will be focussed on NBN and NB (C,N) (BL) and NB3GE (A15) because of their superiority in many areas relative to other members of their classes. The grain-growth inhibition will be achieved by various suitable methods, for example, film layering and controlled recrystallization of amorphous films. The correlation of microstructural parameters with superconducting and mechanical properties will then be sought and interpreted. To obtain the desired microstructure in bulk samples a fast quenching technique will be used. Flux pinning characteristics will be determined and compared with existing phenomenological models to estimate limits of possible critical-current density (JC) enhancement. Alternating current losses will be studied, measured and interpreted. The microstructure related variation of TC and upper critical field will also be studied and the strain sensitivity of superconducting properties determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0059, ION IMPLANTATION IN III-V COMPOUND SEMICONDUCTORS
G.W. Eldridge, Westinghouse Electric Corp., *3 Gateway Ctr., Pittsburgh, Pennsylvania* 15222 (DF040310; F44620-75-C-0034)

AF function - microwave solid state electronic devices are essential components of Air Force reconnaissance, electronic countermeasures and communications systems. Opportunity - continuing systems requirements demand improvements in power, frequency, efficiency and noise properties in solid state electronic devices. Currently, GaAs is being heavily investigated for its properties, but other III-V materials such as INP and gain ASP present the opportunity for higher performance devices due to some of their superior electrical characteristics. Objective - the objective of this research is to investigate the utility of ion implantation into INP and gain ASP for the selective control of doping profile control and junction formation. How work contributes - the control and understanding of ion implantation into these III-V materials will permit the fabrication of high performance microwave devices.

During the first portion of this research year, additional work will be carried out in order to optimize INP implant and encapsulation procedures. In order to determine the effect of substrate quality on the implant results, low dose implants will be made into a variety of iron and chromium doped INP substrates as well as into some undoped VPE layers. Mobility data will then be correlated with these various implanted substrates. Any improvements in mobility or activation efficiency due to radiation damage gettering will also be investigated. work will also continue on trying to improve the low activation associated with P-type implants. Finally, a systematic study of encapsulants will be made. Both carrier concentration and mobility will be profiled in unimplanted and annealed epitaxial layers. In addition, inert gas implants will be profiled to study radiation damage gettering and mobility recovery. In the second half of this research work will begin on gain ASP. First, epitaxial layers of this compound will be grown and characterized. Then work will begin on implants into this epitaxial material followed by encapsulation with silicon dioxide and silicon nitride layers. Inert gas and isoelectronic ions (as well as N-and P-type implants) will be used.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0060, CONDENSATION IN EXHAUST PLUMES
W.D. Williams, Arnold Research Org. Inc., *Arnold Air Force Base, Tullahoma, Tennessee* 37389 (DF420869; F40600-77-C-0003)

To experimentally determine the onset and growth properties of condensate clusters in typical exhaust flume flow fields and the dependence of the condensation process on nozzle geometry, stagnation conditions and flow composition.

Laser Rayleigh/Raman scattering, electron beam fluorescence, electron beam diffraction, static pressure measurements, and method of characteristic calculation will be used to study the onset of homogeneous condensation and the subsequent growth of clusters in nozzle produced hypersonic flows. Nozzle geometry, reservoir conditions, flow composition will be varied to condensation laws and improvement of condensation predictive techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering Development Center

4.0061, FINITE ELEMENT EVALUATION OF THREE-DIMENSIONAL VISCOUS-INVISCID INTERACTING FLOWS ABOUT AUGMENTOR AIRFOILS
A.J. Baker, Computational Mechanics Consultants Inc., *Knoxville, Tennessee* (DN881477; N62269-77-C-0491)

To develop numerical solution procedures for the prediction and analysis of 3-D flows associated with Navy V/STOL aircraft-propulsive systems. Present solution procedures using potential flow techniques have been found to be inadequate. This contract supports work unit NN701, agency accession no. DN481077.

A parabolic partial differential equation system, appropriate for the analysis of 3-D turbulent jet issued from an augmentor wing in cross flow, will be established. A finite element algorithm will be developed for solution of the problem.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

4.0062, STUDIES OF TRANSIENT DISCHARGES
M. Gundersen, Texas Tech University, School of Engineering, Dept. of Electrical Engineering, *P.O. Box 4340, Lubbock, Texas* 79409 (DF049140; F49620-79-C-0118)

AF function - the electrical breakdown of gases play an important role in most applications of pulse power technology. Breakdown is important in switching and for the load itself (laser or plasma). Switches temporal behavior and proper characterization of the electrical load have been difficult to characterize in a fundamental way because of their nature. The mechanisms of laser induced and electron beam initiated spark gap breakdown need to be characterized from a fundamental point of view. Opportunity - recent developments in spectroscopy, including coherent and spontaneous Raman, fluorescence, gating techniques and laser probes, make it possible to measure the population of specific constituents and their excited states. It is possible to investigate small effects which lead to arc formation. Objective - concentrations and states of excitation of both atomic and molecular species in discharges will be monitored with both temporal and spatial resolution. Contribution - for switches temporal behavior, jitter, breakdown characteristics, repetition rate effects and electro-erosion of spark gap electrodes are important. Proper characterization of the electrical load is important for good pulser design, but presently the basic physical mechanisms occurring in such discharges are insuffi-

ciently understood. The mechanisms of spark gap breakdown will be characterized.

Work will continue to study both theoretically and experimentally the initial buildup of charge and current in the gap. A computer code will be developed to solve the equations of motion for the charge densities with space charge effects included. Only limited experiments will be done during the 3 and 1/2 month period and will concentrate on polarity effects for comparison with the computer code. Gap current from the laser induced fireball will be measured with low gap voltage. The second half of the study is the time resolved measurement of electron temperature and density. The temperature will be determined from optical spectroscopy by fitting of spectral line profiles or by comparison of molecular continuum to atomic line emission intensities. An important aspect of this work will oe the implementation of Abel inversion techniques to unfold the spatial variation of the observed spectra. This process involves obtaining a number of different spectra by stepping the image of the arc across the entrance slit of the spectrograph. The data is then processed by computer.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0063, COMPUTATIONAL METHODS IN NONLINEAR MECHANICS

J.T. Oden, University of Texas, Austin Campus, School of Engineering, Dept. of Aerospace Engineering & Engineering Mechanics, *200 W. 21st, Austin, Texas* 78712 (DF052690; F49620-78-C-0083)

AF function - design of future lightweight aerospace vehicles will require an improved knowledge of failure modes and nonlinear behavior in order to achieve a high degree of reliability. Opportunity - new analysis methods which accurately predict nonlinear failure mechanics will have a major impact on future vehicle designs. Objective - to develop new solution methods, convergence criteria and error estimates to nonlinear elasticity problems of the following classes, 1) large deformations, 2) stress singularities, and 3) interface contact. How work contributes - results of this research contribute to the improvement of AF structural analysis methods and methodologies.

For the classes of problems listed in the objective above, several different methods of formulation may be needed to achieve acceptable numerical techniques. It is planned to investigate the use of variational inequalities, penalty methods, LaGrange-multipliers and regularization methods. In order to assess the reliability of these methods for each of the problem classes the development of a priori error estimates will be undertaken. This study will lead to criteria of element trial functions which will guarantee convergence. Finally, the methods will be implemented through computational solutions to verify the accuracy and convergence of the procedures as well as additional special features.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0064, NUCLEAR WASTE DISPOSAL IN SPACE

V. Szebehely, University of Texas, Austin Campus, School of Engineering, Dept. of Aerospace Engineering & Engineering Mechanics, *200 W. 21st, Austin, Texas* 78712

DESCRIPTION: Motion around equilibrium points in space is studied in order to establish stable or quasi-stable orbits with long-range validity. Possible applications are observational satellites for space activities and, more important, nuclear waste disposal.

SUPPORTED BY University of Texas

4.0065, DISTURBED ARMOS. RAD. MEAS.

D.A. Burt, Utah Higher Education System, Utah State University, School of Engineering, Dept. of Electrical Engineering, *Office in Engineering, Room L50, Logan, Utah* 84321 (DF582410; F19628-79-C-0080)

AF function - surveillance and detection, and support of USAF nuclear weapons effects development programs. Deficiency - spatial and time-varying infrared backgrounds interfere with target detection, tracking and identifications. Ionization of the atmosphere interferes with radio wave propagation. A lack of knowledge of the infrared properties and ionization of the upper atmosphere limits our ability to evaluate the effects of nuclear detonations on the aerospace environment. Therefore, these properties must be measured and understood. Research - measurements of infrared atmospheric emissions and of atmospheric ionization under both disturbed (auroral) and undisturbed conditions, utilizing rocket, satellite, balloon and aircraft platforms, supported by both ground based in situ measurements. Laboratory experiments and investigative studies. How research contributes - measurements of atmospheric ionization and infrared emissions provides information about atmospheric molecular composition as well as the spatial and temporal variations. The results of this research are necessary for determining the characteristics of the infrared background, for predicting the infrared radiation from natural (air glow and auroral) sources as well as disturbed (nuclear or otherwise) backgrounds, and for predicting radio wave propagation in a disturbed atmosphere. These results are directly applicable to the design and operation of surveillance and detection systems and communications systems utilizing radio wave propagation.

To provide for the conducting of field measurements utilizing sounding rocket, satellite, aircraft, and balloon platforms, and to provide for the development of new instrumentation and measurement techniques and laboratory simulation studies. This effort is to include-a. Design, fabrication, testing and engineering calibration of instrumentation, including - infrared field-widened interferometer, particle counters, photometers, radiometers, mass spectrometers and langmuir probes. b. Design, fabrication and integration of multi-sounding rocket payloads and field support. c. Development of high power electron accelerators, for stimulating the atmosphere and design of instrumented payloads to carry these accelerators. d. Development of advanced techniques for rocketborne probes of the atmosphere. e. Reduction and analysis of flight measurements data, and studies of these results to determine possible directions of future measurements programs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0066, CORPS OF ENGINEERS REMOTE SENSING COMMITTEE

R.N. Foreman, U.S. Dept. of Defense, Army, Corps of Engineers, Engineer Topographic Lab., *Fort Belvoir, Virginia* 22060 (31642)

OBJECTIVE: To maintain communication and coordination within the Corps on remote sensing research and applications.

APPROACH: The Committee evaluates the remote sensing state-of-the-art; provides technical assistance for remote sensing applications; disseminates remote sensing information; coordinates institutional arrangements for joint efforts and for training; and determines remote sensing data processing, handling, and storage requirements. The Committee determines Corps remote sensing user requirements; recommends priorities; and, where possible, ensures that Corps needs are considered in the development of NASA's and other agencies' systems.

SUPPORTED BY U.S. Dept. of Defense, Corps of Engineers, Engineer Topographic Lab.

4.0067, NIOBIUM BASED JOSEPHSON JUNCTIONS

J.E. Nordman, University of Wisconsin, Madison Campus, School of Engineering, Dept. of Electrical Engineering, *Madison, Wisconsin* 53706 (ENG74-24227 A02)

The primary objective of this research is to understand and perfect the niobium (Nb) based Josephson tunnel junction. Specific goals include: 1) the determination of the mechanisms responsible for leakage current, the anomalous negative resistance, and the reduced maximum DC Josephson current - all now observed as functions of fabrication parameters in Nb-Nb oxide-lead (Pb) junctions; 2) the fabrication of junctions exhibiting repeatable behavior using semiconductor barriers which can be altered in a controlled way either by doping, optical injection or the field effect; 3) the determination of the limits to the efficiency of coupling of elecromagnetic radiation to Nb tunnel junctions through either the Nb or the Pb film.

The Nb based junction will be studied because of its great potential for use in practical Josephson devices. In that regard, effort will be directed toward achieving one or more of the following: a better circuit model for Nb junctions, development of a low leakage Nb-barrier-Nb junction, development of efficient high frequency emitters or detectors development of reliable high current density junctions.

This is a continuation of research previously supported under NSF Grant ENG-7424227.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0068, UNSTEADY AIRLOADS ON A SINUSOIDALLY OSCILLATING SUPERCRITICAL AIRFOIL
H. Tijdeman, National Aerospace Lab., *Amsterdam, Netherlands* (DF048340; AFOSR-77-3297)

AF function - aerospace vehicles. Deficiency - there is a lack of reliable experimental unsteady aerodynamic data at transonic speeds. These data are required for analysis and for validation of unsteady transonic aerodynamic theories. Objective - to obtain accurate unsteady aerodynamic measurements at transonic speeds on two dimensional airfoils - unsteady wall effects will also be investigated. How work contributes -unsteady transonic aerodynamic data are required for evaluation of -flutter characteristics of aircraft, flutter characteristics of helicopter rotor blades, gust response of aircraft performance of helicopter rotor blades, and design of active control systems. The acquisition of accurate unsteady aerodynamic data in which the effects of model scale and facility wall configurations will be evaluated should serve as a standard for the comparison and evaluation of the new generation of calculation methods for unsteady transonic flow.

This is a collaborative program between NASA AMES and the NLR (which has requested nominal Air Force support for their portion of the program). The NLR 7301 airfoil will be investigated in both the NLR transonic tunnel and the NASA AMES 11 by 11 foot transonic wind tunnel. Both the NLR and NASA AMES tests will investigate the amplitude and phase relationships of the pressure distribution and the resultant integrated forces over a range of mach numbers, angles of attack, Reynolds numbers and reduced frequency. Sufficient data and details of the test facilities pertinent to evaluating wall and scale effects will also be provided as well as details of the test techniques including data acquisition and reduction procedures. It is expected that the close cooperation of the two research laboratories will result in greater progress to improve data accuracy and reliability in a shorter period of time than would be possible by each group working independently.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, NAVY ENVIRONMENT - FOG ANALYSIS
H. Loos, Laguna Research Lab., *21421 Stans Ln., Laguna Beach, California* 92651 (DN675223; N00014-76-C-0436)

The objective of this research is to analyse and select from the electrical mechanisms operative in the coalescence of fog drops that one which is theoretically optimum as the basis for field trials of fog modification experiments. Better environmental support of naval operations constitutes the relevance of this research.

Details of the analysis will include size of charged drops in relation to fall speed and dwell time in the fog, extent of charge, relative numbers of seed drops in relation to fog density, means of production of charged drops, avoidance of corona and discharge limits for amount of charge placed in cloud, etc.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0002, SALINITY INVESTIGATIONS IN THE WEST SALT CREEK WATERSHED, COLORADO
L.D. Whittig, University of California, Davis Campus, School of Agricultural & Environmental Sciences, Dept. of Land Air & Water Resources, *Davis, California* 95616 (B-201-CAL)

The salinity of the Colorado River impacts seriously on agriculture, municipalities and industries. Projected increases in salinity indicates that agricultural damage alone will increase by up to 21 million dollars per year by the year 2010. Over 70% of the total salt load originates in the Upper Colorado River Basin and over 50% is from natural lands.

Preliminary field investigations have indicated a relationship between salt concentrations and species in the area, to vegetation, soil types and landforms. Preliminary X-ray diffraction analysis has identified a number of complex salt species not previously reported in the area.

The proposed research is aimed at the assessment of the potential contribution of salts and sediments to the Colorado River from a representative watershed and the identification of parameters for the prediction of the salt and sediment loading potentials of other similar natural areas. Field and laboratory investigations coupled with existing information from aerial photographs, geological and soil maps will yield a map of the study area identifying salt locations, concentrations and species, and the potential for salinization and sedimentation of streams in the area. This information will be extremely valuable for land use planning and management decisions and for the establishment of salinity control.

SUPPORTED BY U.S. Dept. of the Interior, Office of Water Research & Technology

5.0003, SATELLITE-BASED AVIATION WEATHER FORECASTING
T.H. Vonder Haar, Colorado State University, School of Engineering, Dept. of Atmospheric Science, *Fort Collins, Colorado* 80523 (DF581930; F19628-78-C-0207)

AF function - weather observation, analysis and forecasting. deficiency or opportunity - lack of adequate information to meet military weather support requirements. Objective - develop a procedure to utilize relatively fine scale geosynchronous satellite data (GOES), conventional synoptic scale weather data and a trained forecaster to produce improved short-range forecasts of terminal weather conditions. The procedure will emphasize automated forecast techniques and by careful monitoring of weather conditions will bring in the forecaster only where large and important weather changes are imminent. How development contributes - a successful development of this procedure will lead to improved short-range forecasts and also to a reduced workload for centralized forecasters.

A system will be set up to make automated short-range forecasts at a number of locations using geosynchronous satellite data. The computer will also scan objective forecasts and observations for the same locations. A technique will be developed to isolate locations and times when important, unforecast changes are likely to occur and a forecaster using satellite information could improve upon the forecast.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0004, CORONAL TRANSIENTS
L.V. Batlin, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8DJ44980)

PROJECT OBJECTIVES: 1) To gain a better understanding of the fundamental physical properties in solar events and in the coronal transients produced by solar events. 2) To calculate the arrival at the earth of material ejected in solar events in order to forecast when geomagnetic storms and disruption of communications may occur. 3) To study the physics involved in the interaction of various interplanetary disturbances and discontinuities.

CURRENT YEAR PLAN: Perform additional studies using the one-dimensional code, add the third component of the magnetic field and velocity, include the effect of thermal con-

duction in the code, continue the development of the two-dimensional MHD code applicable to the inner corona.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0005, ENGINEERING SUPPORT

D. Sirmans, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8C370409)

PROJECT OBJECTIVE: Design, operation and maintenance of NSSL's radar, 1500' tower surface observation network facilities. Implementation of improvements to these and other laboratory facilities such as the surface digitized network and atmospheric electricity facility by design and development of new hardware to establish or enhance the capability of these programs.

CURRENT YEAR PLAN: Plans include continued upgrading of the NRO and CIM Doppler radar systems to improve the systems for meteorological research. Changes include: receiver components for improved detection, standardization of acquisition parameters, and changes to increase transmitted power in 'long pulse' mode. Plans also include the establishment of a land time data link between NRO and CIM radars. The Digitized Surface Network will be upgraded by; design and development of photovoltaic power source design and development of a data telemetry system continuing system modification to improve accuracy and reliability. New engineering efforts also include development of ground clutter suppression techniques for coherent and incoherent radars and a study of radar polarization diversity for meteorological radars.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0006, SOLAR X-RAY IMAGER

J. Cessna, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., *Environmental Research Lab., 14th & Constitution Ave. N.W., Washington, District of Columbia* 20234 (8B240455)

PROJECT OBJECTIVE: To complete a study of the feasibility of a next generation solar x-ray imager instrument.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0007, REVISION OF STATISTICAL-DYNAMICAL NHC73 MODEL

C.J. Neumann, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Hurricane Center, *P.O. Box 248286, Coral Gables, Florida 33124*

OBJECTIVE: NHC73 is a statistical-dynamical model which uses the output from the National Meteorological Center *(NMC) Primitive Equation (PE) model in a statistical prediction* framework. The model has not performed well in the tropics or other data sparse areas in recent years. Part of the problem is *related to the fact that the model is based on the 500mb level* and that level is poorly analyzed in the data-sparse areas. The objective of the study is to reconstruct the model such that the *predictors are commensurate with current analysis* and prognosis capabilities.

APPROACH: This study will extend over at least two *years. The focus during FY 1980 will be to* experiment with various types of predictors and analyses using the 'perfect-prog' and 'Simulated Model Output Statistics' methods. A purely *Model Output statistics model will also be attempted* although the sample size may prove to be too small. In lieu of the 500mb height fields currently used in the NHC73 model, deep-layer *mean height fields will be substituted.* This provides additional input from the more data rich upper (cirrus) and lower (cumulus) levels as observed by satellite.

PROGRESS: A data set has been structured for the years 1965 -1977. The set consists of deep-layer-mean heights over a storm centered grid for approximately 1000 Atlantic tropical cyclone forecast situations. Each set consists of -24, -12, 0, plus 12, plus 36, plus 48, plus 60 and plus 72 hour analyses relative to an initial time. Also included in each set are the past, present and future storm positions and intensities at 12h intervals. Experiments are being conducted with various stratifications of the data set and with various grid spacings and grid orientations.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Weather Service

5.0008, EOMET AND MARINE FOG FIELD INVESTIGATIONS IN THE GULF OF MEXICO

J.B. Russell, U.S. Dept. of Defense, Navy, Naval Avionics Facility, *Indianapolis, Indiana* 46218 (DN797002)

To investigate the atmospheric marine boundary layer in order to provide an understanding of its influence on the propagation of electromagnetic radiation and on the formation, maintenance, and dissipation of marine fog.

Meteorological, micrometeorological and microphysical measurements in the marine boundary layer, as well as oceanographic measurements, will be made. Measurements will be made from fixed platform, ship and aircraft.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

5.0009, SEASAT PROGRAM - RESEARCH APPLICATIONS WITH TROPICAL CYCLONE DATA SETS

R.C. Gentry, General Electric Co., Management & Technical Services, *5030 Herzel Pl., Beltsville, Maryland* 20705 (7-931; MO-AO1-78-00-4323 MOD #2)

OBJECTIVE: Use wind, temperature and moisture measurements from SMMR and SASS, together with all other available sets taken over three tropical cyclones, to evaluate usefulness of SEASAT-A for hurricane observations in 1978. Compare value of this full data set with requirements for making hurricane forecasts.

APPROACH: SEASAT data obtained on a moderate disturbance, a tropical storm and a tropical cyclone of full hurricane intensity is being investigated. All three cases were selected to insure maximum data availability, but the full hurricane case will further cover periods when the geosynchronous satellite was operating in the limited scan mode for the storm area and the NOAA Research Flight Center had one or more of its aircraft gathering data in the storm at low levels. Data from all sources is being inter-compared in order to assess data validity and to set limits on probable errors in the various types of data. These data are being used to study the structure and energetics of the three storms of varying intensity.

CURRENT PROGRESS: Preliminary evaluation of the SEASAT data in hurricane situations indicate that very useful results will be obtained. For example, a comparison was made between the SEASAT winds prepared from the SASS data using a preliminary WENTZ algorithm and the winds derived from the high frequency imagery of GOES for the Hurricane *Ella case (1 September 1978).*

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic *& Atmospheric Admin., National* Environmental Satellite Service

5.0010, STUDIES OF AURORAL FIELD-ALIGNED CURRENTS WITH THE TRIAD SATELLITES

T.A. Potemra, Johns Hopkins University, Applied Physics Lab., *Johns Hopkins Rd., Laurel, Maryland* 20810 (ATM79-15238)

This grant continues the acquisition, analysis, and interpretation of the vector magnetic field data obtained from the Navy/APL satellite TRIAD. The TRIAD magnetometer experiment remains the only means of studying magnetic disturbances in the auroral and polar regions at relatively low satellite altitudes (approximately 800 km).

The data collection from Kiruna, Sweden, Resolute, *Canada and McMurdo, Antarctica will continue.* An up-dated 'digital' TRIAD ground station will be installed in Chatanika, Alaska to acquire data in correlation with the major radar *system there. The present 'analog' TRIAD* stations in Resolute and McMurdo will also be updated.

The principal objective of the program is to continue the investigations of the relationships of the characteristics of Birkeland currents with a variety of phenomena including auroral current systems, deduced from radars and surface magnetic measurements, polar cap and optical emissions, auroral kilometric radiation, and interplanetary magnetic field variations. It is also planned to use the TRIAD data for the 'event-centered' IMS studies presently being conducted.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0011, SATELLITE ALTIMETRY

B. Chovitz, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Ocean Survey, Geodetic Research & Development Lab., *6001 Executive Blvd., Rockville, Maryland* 20852 (836910A5)

Measurements of altitude to the ocean surface from a satellite will provide, in the first approximation, information on the shape of the geoid assuming that sea level corresponds to the geoid, and in the second approximation information on tides, currents, salinity, and sea state which are deviations of sea level from an equipotential surface. The first use of satellite altimetry will therefore be geodetic and serve as a basis for the later oceanographic applications. The altimetry will provide direct dense measurements of geoidal heights on a global scale not possible by any other means. It will also aid in improving the figure of the Earth as a whole in combination with other data.

Technical objective is to carry out analyses and provide computer programs in anticipation of data to be received from satellite altimetry. These programs not only handle altimetry, but provide a precise ephemeris of the satellite, which is required to exploit the precision of the altimetry.

Task is of ongoing nature. It is anticipated that a continuously improving flow of data from successive NASA satellites will be forthcoming through this decade. Technical reports of progress will be issued when significant results have been achieved.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Ocean Survey

5.0012, DATA AUTOMATION - AUTOMATIC RADIOTHEODOLITE (ART)

R.R. Reynolds, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Weather Service, Systems Development Office, Equipment Development Laboratory, *8060 13th St., Silver Spring, Maryland* 20910 (8AA8601)

OBJECTIVE: To automate, to the greatest possible extent, data ingestion, processing and dissemination in Ground Meteorological Device (GMD) and Weather Bureau Remote Theodolite (WBRT) upper air observation systems.

APPROACH: Conversion from pressure-commutated to time-commutated radiosondes. Design and develop ART interface board and ART software. Test and evaluate radiosonde, *ART hardware and software. Evaluate the performance of the* ART system at several Upper-Air field locations.

PROGRESS: Time commutated radiosondes are being *tested and evaluated. ART minicomputer interface board was* designed, with engineering models being evaluated. The existing ART software is currently being modified to accommodate the *time commutated radiosonde data transmission and subsequent* processing and dissemination.

SUPPORTED BY U.S. Dept. of Commerce, National Weather Service, Systems Development Office

5.0013, AN OBSERVATIONAL STUDY OF THE PUGET SOUND CONVERGENCE ZONE

C.F. Mass, University of Maryland, College Park Campus, Graduate School, *College Park, Maryland* 20742 (ATM79-15153)

Local differences in weather elements such as winds, cloudiness, and rain are not infrequently caused by varying topography of the region. The Puget Sound region of Washington serves as an example. Air flowing around the Olympic Mountains at times becomes blocked by the Cascade Range and the resulting convergence promotes local cloudiness and precipitation.

The objective of this study is to define the meterological conditions necessary for the Puget Sound convergence zone to become established; to identify factors that influence its life-cyle and weather elements associated with it; and to learn its influence on local climatology. Finally, rules using routine weather information, to predict the occurrence of the convergence zone are sought.

The study uses meteorological data from a variety of routinely available sources and analyzes the life-cycle of individual, well-documented cases of convergence zone formation and evolution. From these, statistical analysis and synthesis of an average convergence zone situation will be used to achieve the objectives of the study.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0014, EWER PROBE EFFICIENCY STUDY

H.G. Norment, Atmospheric Science Associates, *363 Great Rd., Bedford, Massachusetts* 01730 (DF583580; F19628-79-M-0005)

Air Force function - strategic offense and defense. Deficiency -inability to accurately measure the liquid (or ice) water content of the atmosphere. This can degrade weapon system performance and affect aircraft operation. Objective - to accurately measure the concentrations of liquid water and/or ice mass of cloud systems. How development contributes - this study will permit more accurate measurements of atmospheric ice or water contents with the EWER instrument thereby providing accurate liquid water content(LWC) computations for quantitative assessments of environmental effects on aerospace operations.

Study the airflow in and about EWER probes to determine the efficiency of collection of hydrometeors and ice crystals as a function of size and shape.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0015, NAVY ENVIRONMENT - REMOTE SENSING OF SUBSURFACE TEMPERATURE AND SALINITY

D.A. Leonard, Computer Genetics Corp., *4 Lake Side Office Park, Wakefield, Massachusetts* 01880 (DN675692; N00014-76-C-1007)

The research is to investigate the feasibility of using Raman spectroscopy to obtain information on temperature and salinity in coastal waters. There, particular difficulties not encountered in the open ocean are expected because of the large magnitude of salinity and temperature gradients, heavy sediment load and high occurrence of fluorescent material.

A pulsed laser with appropriate wave lengths, mounted on a boat, will excite the water column under it; the backscattered signal will be gated or triangulated to provided locality and analyzed for wavelength and polarization to obtain Raman information. The measurements will be made in natural waters off the East Coast.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0016, DIFFUSION OF STRATOSPHERIC POLLUTION

J.L. Larson, Hycor Inc., *1 Gill St., Woburn, Massachusetts* 01801 (DF582730; F19628-79-C-0028)

Small frangible canisters are packaged into a dispensing system that can release smoke in a controlled manner a known distance below a balloon platform. The puff history, after release, is observed by tv and camera systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0017, SATELLITE DATA PROCESSING AND ANALYSIS

R.W. Fioretti, R D P Inc., *Waltham, Massachusetts* 02154 (DF247630; F19628-76-C-0244)

AF function - airborne surveillance, target acquisition. deficiency - atmospheric density variations with time and space cannot be accurately predicted. Research - direct density measurements with satellite-borne accelerometers. Results are correlated with solar-geophysical parameters and other experiments. How research contributes -permits accurate determination of Air Force satellite ephemerides.

A seta accelerometer is to be flown on air force satellites. This instrument permits high accuracy, high resolution atmospheric density measurements. Telemetry data from all the experiments will be provided on tape. The raw seta data will consist mainly of drag accelerations which are proportional to density and accelerations due to vehicle motions caused by thrusting. Digital filtering methods are used to determine those accelerations due to drag. Density is calculated directly from the drag data. These results are used to accurately determine the orbit of the satellite. In addition the density results are used to developing accurate atmospheric models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0018, CLOUD SPECIFICATION BY AUTOMATIC MULTISPECTRAL IMAGERY ANALYSIS

R.K. Mehra, Scientific Systems Inc., *1640 Massachusetts Ave., Cambridge, Massachusetts* 02138 (DF248620; F19628-77-C-0208)

Af function - all weather operation of tactical and strategic forces. Deficiency - limited ability to specify and forecast cloud conditions globally in real time. Development - develop numerical techniques to specify cloud conditions automatically using multispectral imagery data from existing and potential sensors on meteorological satellites. How development contributes - improve ability to specify cloud altitude, to determine whether cloud is ice or water, and to detect areas of precipitation.

Combine imagery information from visible, near IR, IR, and microwave frequencies. Utilize available satellite imagery and model imagery for frequencies not yet available.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0019, INVESTIGATIONS INTO TECHNIQUES FOR MEASURING STRATOSPHERIC TURBULENCE

G. Murphy, Tri Con Associates Inc., *Cambridge, Massachusetts* (DF580530; F19628-78-C-0194)

AF function - environmental impact statements of high altitude Air Force operations. Deficiency - current or anticipated Air Force operations in the stratosphere may deposit harmful material and it is important to be able to assess the dispersion and residence time of such material in the stratosphere. Objective - provide research into various techniques for measuring winds and turbulence at stratospheric altitude. This will lead to profiles of the dynamic stratospheric wind fields. How research contributes - this research is needed in order to design, develop and fabricate new instrumentation which will measure stratospheric winds and turbulence. This will provide information leading to an understanding of atmospheric transport which is important in assessing the impact of systems which may contribute to environmental pollution.

Investigate, design, develop new techniques and devices to measure stratospheric winds and turbulence with a frequency response of DC to 1KHz for altitudes up to 45 km. Devices may be but are not limited to corona and hot wire anemometers. Desired linear velocity range is 0-25 m/s with a resolution of 0.001 m/s. Instrumentation is to be balloon launched from remote sites in USA.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0020, BLN PAYLOAD DESIGN

A.H. Howell, Tufts University, Medford Campus, School of Engineering, Dept. of Electrical Engineering, *Medford, Massachusetts* 02155 (DF584800; F19628-80-C-0060)

AF function - instrumentation of free and tethered balloon systems for scientific and technical experiments. Deficiency or opportunity -exploit the performance potential of balloons by designing systems for highly specialized scientific payloads or for unusual flight performance requirements. Objective - to provide analysis, design and limited fabrication of critical components of balloon-borne payloads for special applications. How research contributes - appropriately designed, instrumented balloon systems provide efficient often uniquely useful high altitude and tethered platforms for emergency communications, surveillance and optical observations.

A lightweight, steerable, stable platform will be designed and built to maintain the line of sight of tethered-balloon payloads such as optical sensors or antennas, independent of the natural motion of the tethered system, and to change this orientation by command.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0021, COHERENCE TIME OF IONOSPHERIC REFRACTION

R.S. Allen, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580890)

AF function - advanced radar and navigation systems. Deficiency -the sensitivity of radars which track deep space targets is severely limited by rapid loss of radio phase coherence caused by the time rate of change of refractive effects within the ionosphere. Objective -develop a technique to predict median coherence times for existing and proposed ADCOM radars which must perform deep space surveillance. Provide ADCOM with estimates of the hour to hour variability of the refractive effect with respect to its median value. How research contributes - provides basic statistics on coherent integration time which can be used in system design and trade off evaluations for range extension to SPADATS radars and for the deep space surveillance radar system.

Use AFGL models and data to develop a technique to predict the median coherent integration time for existing and proposed ADCOM radars. Acquire and analyze observations representative of deep space radar sites to estimate the hour to hour variability of the coherent integration time.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0022, AIR LAUNCHED BALLOON TECHNIQUES

A.S. Carten, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF580610)

AF function - advanced balloon systems (surveillance, reconnaissance, communications, environmental research support). Deficiency or opportunity - present vehicles have limited altitude and payload capabilities. Objective - to develop an all weather operational lighter-than-air (LTA) vehicle or platform to put high altitude sensors and communications relays on station quickly and on short notice over battle theaters. How research contributes - this work involves in-house studies and investigations leading to the design, fabrication and test of an advanced prototype air-launched balloon system (ALBS). When the goals of this research are achieved it will be possible for the Air Force to deploy and inflate in mid-air, automatically and quickly, LTA platforms capable of supporting payloads of at least 200 lbs for 24 hours at altitudes of 70,000 ft or better. This capability will enhance the effectiveness of Air Force missions whose mode of operation requires the rapid availability of low cost substitute aerial platforms for communications relays like those presently carried on space satellite systems. TAC ROC 305-75 points up the need for such a substitute and specifically mentions LTA platforms.

The basic design configuration of the cryogenically-inflated ALBS has been worked out under IHWU 66651101, in which scientific balloons were chosen as the primary drop vehicles. Using data from that program, a more sophisticated, aircraft-oriented version of the system will be developed under IHWU 16591101 which will meet the stringent standards required of aircraft-borne equipment. To accomplish this goal the parachute system tested and refined during FY77 at the National Parachute Test Range will be adapted to the new hardened version of the ALBS and subjected to qualification tests at the NPTR. The ALBS balloon design will be modified as required to reflect any needed design improvements identified in the IHWU

66651101 test program. Also, the ALBS cryogenic gas storage and heat storage transfer unit used on that program will be redesigned by NBS, as a single Dewar of the required capacity and a model of this design will be procured for the planned test series. When the new aircraft-qualified system is assembled it will be launched over the WSMR at the designed operational altitude of 25,000 ft. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0023, STRATOSPHERE-MESOSPHERE TIME-SPACE RELATIONSHIPS

A.E. Cole, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF581530)

AF function - design and operation of aerospace vehicles. Deficiency - distribution as well as time and space variations of wind and the thermodynamic properties of the atmosphere for levels up to 100 km must be known in order to establish design criteria and operational procedures for various types of reentry vehicles. Objective - to develop mathematical models of the atmosphere which portray the time and space variations of temperature, density and wind at altitudes up to 60 km and complete a set of mean monthly atmospheres to 90 km for 15 degrees intervals of latitude. How development contributes - a more detailed knowledge of atmospheric structure below 100 km will be important in targeting and in the design of systems for intercepting ballistic missiles.

Mathematical models of the atmosphere will be developed using all available rocket observations of temperature and density at heights between 30 and 100 km and appropriate radiosonde data for levels below 30 km. Statistical techniques will be used to develop models of the time and space variations of temperature, density and wind for levels up to 60 km. Statistical arrays that describe the decay in the coefficients of interlevel correlations with increasing altitude separation will be derived from analyses of radiosonde and rocketsonde data. The decay of the coefficient of correlation of temperatures and densities between two points with increased horizontal separation will be developed from nearly simultaneous observations for various locations and from data taken from published 10,5, 2 and 0.4 mb maps, prepared on a weekly basis by NOAA. The decay in the correlation coefficients with time (1-24 hours) will be developed from published observations. Part of the work under this work unit was formerly carried out under work unit 86240106.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0024, LOWER ATMOSPHERE REMOTE SENSING ASSESSMENT

D. Fitzgerald, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF582950)

AF function - low altitude aircraft operations. Deficiency - unexpected low level turbulence and wind shear effects can adversely affect flight safety and mission performance. Objective - to investigate methods for obtaining improved precision in measurement of low level wind parameters and temperature-humidity profile anomalies. How research contributes - advances in measurement will lead to better warnings of hazardous landing conditions and to improved support for near surface operations.

A detailed analysis will be made of the conditions of applicability of all identifiable low altitude remote sensing techniques. Inputs to the analysis will consist of published reports and engineering data combined with site visits to organizations actively engaged in the construction and use of equipment for remote sensing. present operational experience regarding the utility and limitations of the various techniques will be determined. Approaches for further improvements in sensor performance will be identified and recommendations made for future lines of development of the most promising techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0025, SYNCHRONOUS ENVIRONMENT SPECIFICATION

H.B. Garrett, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF249050)

AF function - AF communications satellites at synchronous orbit are degraded by satellite charging induced by the plasma environment. Deficiency - the space environment during periods of satellite charging is not sufficiently defined. Objective - to plan for and conduct a rapid interpretation of the environmental data returned by the SCATHA satellite in conjunction with the SCATHA engineering sensors so that adequate design criteria might be developed to prevent degradation of future satellite communications systems. How research contributes -understanding of the satellite charging phenomenon is necessary so that steps may be taken to prevent damage to satellites from electrostatic discharges (ESD). Knowledge of the geosynchronous environment is needed to interpret the causes of spacecraft charging and to complement efforts aimed at computer simulations of the spacecraft-environment interaction.

Data from the ATS-5 satellites will be analyzed to produce an environmental atlas. This atlas will consist of a statistical description of the ambient geosynchronous plasma. Plans will be made to incorporate the SCATHA (satellite charging at high altitudes) satellite data into a final comprehensive specification of geosynchronous and near-geosynchronous plasma environment. This final atlas will be the basis of a statement to be included in AF contractor's SOW's.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0026, PRELIMINARY BEAM-PLASMA INTERACTION STUDIES

J.R. Jasperse, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF583670)

AF function - satellite surviability, communications and surveillance. Deficiency - the characteristics of energetic charged-particle beams injected inthe earth's ionosphere and magnetosphere are not understood well enough to assess the space-environmental effects produced by such beams. Objective - to develop knowledge of the injection, propagation, reflection and deposition of energetic electron beams in the earth's ionosphere and magnetosphere. How research contributes - will provide an understanding and review of the literature in the field and a recommendation of specific areas requiring further study.

The data and pertinent literature in the field will be surveyed. In an attempt to understand the data, preliminary calculations will be performed. Directions for future analytical work will be determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0027, SATELLITE DENSITY MEASUREMENTS USING IONIZATION GAUGE INSTRUMENTATION

J.P. McIsaac, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF581200)

AF function - low altitude, operational satellites, airborne surveillance, ballistic nuclear weapon delivery. Deficiency -inaccuracies in the determination of low altitude satellite ephemerides due to inadequate data on density variation at critical altitudes. Objective - acquisition of atmospheric density measurements on a global scale, to define, correlate and/or relate results empirically with solar and geophysical phenomena. How research contributes - permits direct accurate measurements of density providing inputs to be used in the development and upgrading of forecasting techniques.

Ionization gauge instrumentation will be flown onboard the S77-2 spacecraft providing measurements of atmospheric neutral density during a year in which solar activity is on the increase approaching its maximum peak period. Instrumentation using ionization gauges also includes a motor activated air stream modulator. These S77-2 flight units are capable of direct measurement of atmospheric gas density but will also be flight tested for potential applications as atmospheric gas temperature monitors.

Data acquired in this flight will be utilized and merged with the S3 satellite density data base for use in empirical studies as well as analysis and correlation investigations of a statistical nature.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, SATELLITE AURORAL ELECTRON MEASUREMENTS
R.P. Vancour, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF584710)

AF function - communications in and through the ionosphere, surveillance and detection. Deficiency - disruption in high latitude and HF communications systems and anomalous operations of space systems during magnetically disturbed conditions. Objective - to further knowledge of the mechanisms and sources causing intense auroral magnetic activity and to apply results toward improving existing substorm models needed to predict such activity. How research contributes - charged particle flow along magnetic field lines is an important mechanism in transferring energy from the magnetosphere to the auroral ionosphere. Energy dissipation occurs through auroral formations and ionospheric current flow in producing substorm activity. Improving existing substorm models can result from improving the definition of this mechanism.

Data from two electron electrostatic analyzers (90 degrees apart) which measure electron fluxes in the energy range of 50 eV to 20 keV are aboard the polar orbiting, sunsynchronous Air Force satellite P78-1. The satellite will remain in the noon-midnight meridian which greatly increases the probability of substorm occurrence in the satellite trajectory. All levels of magnetic activity will be studied, particularly intense activity (substorm). Results will be compared with other P78-1 experiments which investigate auroral activity, as well as experiments on other satellites and ground-based measurements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0029, AURORAL-E COMPOSITION AND DYNAMICS
W.K. Vickery, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF584460)

AF function - trans-ionospheric communications, and surveillance systems, remote ionospheric monitoring. Opportunity - potential exists for development of a satellite-borne wide-area remote ionospheric monitoring system to provide environmental support to communications and surveillance systems. Objective - experimentally test models of ionospheric processes to determine if electron density profiles can be accurately determined from remotely sensed optical measurements. How research contributes - rocket-borne experiments will provide the composition and dynamics inputs to the ionospheric to the ionospheric models being generated in the Auroral-E program.

Measurements of ionospheric and neutral composition are being measured by a rocket payload containing a switched ion/neutral mass spectrometer. The payload will also contain an energetic electron analyzer and electron density probe. The neutral atmospheric, neutral dynamics will be measured by a second payload to determine winds, shears, turbulence and turbopause altitude. The mass spectrometer will provide a fairly complete description of the auroral plasma, yielding above 100km, distributions of all ionic species as well as neutral argon and nitrogen.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0030, TRAJECTORY AND TEMPERATURE ANALYSES OF SATELLITE TRACKED BUOY OBSERVATIONS IN THE NORTH PACIFIC
A.C. Vastano, Texas A & M Research Foundation, *Faculty Exchange Box H, College Station, Texas* 77843 (OCE79-21271)

This project is part of the North Pacific Experiment (NORPAX). The long-range goal of NORPAX is to understand fluctuations in the upper layers of the Pacific Ocean with time scales of months to years and space scales in excess of 1,000 kilometers, and the relationship of these oceanographic fluctuations to the overlying and adjoining atmosphere. Achievements of this goal should eventually lead to improved weather/climate prediction for both the Pacific Ocean and North America.

The complete set of Anomaly Dynamics Study satellite-tracked drifting buoys will be examined to characterize the mean and mesoscale perturbations for the eastern North Pacific. A similar treatment will be applied to the sea surface temperatures measured by the drifters.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Ocean Sciences

5.0031, TERRAIN FORECASTING ANALYSIS (THE ELECTROMAGNETIC & THERMAL PROPERTIES OF SOILS, STUDY OF THEIR CLIMATE (ABBREV)
R.A. Falls, U.S. Dept. of Defense, Army, Mobility Equipment Research & Development Command, Mine Detection Div., *Fort Belvoir, Virginia* 22060 (DA0M3687)

To forecast the moisture, thermal and the electromagnetic properties of all soil textural types (sand, loam and clay) in remote areas by the study of the climate and geological environment.

The intent is to store in a computer world-wide soil and climatic data and apply this data to imperical equations developed for determining a regions' soil moistrue. Once this seasonal change of moisture is established it is tantamount to securing the soils' electrical, thermal and surface trafficability.

SUPPORTED BY U.S. Dept. of Defense, Mobility Equipment Research & Development Command, Mine Detection Div.

5.0032, COMMUNICATION FADING AT MAGNETIC EQUATOR
E. Bonelli, Universidade Federal do Rio Grande do Norte, *AV. Hermes da Fonseca 780, Natal, Brazil* (DF249300; AFOSR-78-3613)

AF function - communications. Deficiency - communications outages, radar errors and false targets. Objective - to provide observational data of ionospheric deep fading parameters at magnetic equator. How research contributes - results used in statistical models of fading depth and occurrence.

The approach is to observe and record signals from suitable transmitting satellites at ultra high and l-band frequencies. The data are reduced and furnished to AFGL in the form of punched cards. These data contribute to the understanding of the ionospheric irregularity structure found at the equator - at this time the longitudinal variation of equatorial scintillation is being investigated by means of these and similar data from other observations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, HEALTH HAZARD ASSESSMENT AND IMPLICATIONS OF WHOLE-BODY VIBRATION ASSOCIATED WITH ADVANCED COMBAT VEHICLE TECHNOLOGIES (DA0C6900)
J.C. Johnson, U.S. Dept. of Defense, Army, Medical Research & Development Command, Field Research & Biomedical Applications Div., *Fort Rucker, Alabama* 36362 (DA0G0175)

To assess the effect of whole-body, low-frequency vibration and noise peculiar to advanced combat vehicles on the human visual, vestibular, hearing, and musculoskeletal systems. Correlate these effects in relations to their relative hazards to acute or chronic injury potential and influence on crew performance, comfort, and efficiency. Develop health criteria recommendations for vehicle and subsystem design and operation.

The approach will be multidisciplinary in nature. Dynamic characteristics of the high survivability test vehicle-light (HSTV-l) semi-supine seat will be determined by Fourier trans-

form techniques using instrumented human subjects in the vheicle and on the USAARL multi-axis vibration table. Stress and fatigue reactions to long term (greater than 4 hrs) exposure including neck muscle stress and fatigue associated with operation of video displays, target acquisition system, and head coupled vibration will be assessed by standard biochemical and psychophysiologic as well as specialized electromyographic techniques. Dynamic visual acuity and eye fatigue will be studied under multiple conditions of target, display, head and eye movement, and frequency phase controlled vibration, contrast, and luminance. Effects of noise interaction with directly coupled head vibration will be studied using serial audiograms and vestibular function criteria. Selection narrow-band, low-frequency noise and vibration effects will be correlated on a large statistical animal population. Supine whole-body vibration effects on respiratory rate, thoracic and pulmonary compliance, cardiac output, peripheral blood flow, and blood oxygen saturation will be determined. mathematical modeling of the dynamic interactions as needed.

SUPPORTED BY U.S. Dept. of Defense, Medical Research & Development Command, Aeromedical Research Lab.

6.0002, ASPT IP INTEGRATED DYNAMIC VISUAL DISPLAY DEVELOPMENT
R.G. Woodruff, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Williams Air Force Base, Chandler, Arizona* 85224 (DF224240)

The objective is to develop an integrated dynamic visual display for the ASPT advanced instructor/operator station (AIOS) which will provide aircraft flight status information and predictor display information, including such parameters as airspeed, altitude, attitude, angle of attack, heading, g force and desired track. Ultimately the display will be used by instructor pilots in conjunction with the performance of flying training research in the ASPT.

Phase I - display design. IPS will be administered a questionnaire to determine what integrated display information would be useful to them for evaluating student pilot performance. From the analysis of the data, several display designs will be developed and sketched. IPS will then rank order the various designs. Phase II -display evaluation. The two highest ranking designs will be implemented on the ASPT AIOS. Ten IPS will each instruct one student under each display cofiguration, in addition to a condition in which only the usual AIOS/CI information is available. The number of trials required to reach a criterion level of proficiency will be recorded. IPS will be administered a questionnaire to determine the preferred display configuration. Parameteric and non-parametric statistical tests will be used to analyze the trials-to-criterion data and questionnaire data, respectively. If modified display is recommended, the cycle will be repeated until an optimal design is identified.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, PROTOTYPE HYDRAZINES ELECTROCHEMICAL ANALYZER
M. Shaw, Interscan Corp., *9614 Cozycroft Ave., Chatsworth, California* 91311 (DF323880; F33615-78-C-0607)

Survey monitors need to measure trace concentrations of the hydrazine rocket fuels in air to detect use area leaks and to protect personnel. Presently, available monitors lack portability, reliability and/or sensitivity. The state-of-the-art in electrochemical analyzers is now sufficiently advanced to provide the sensitive monitors needed at low cost. A portable hydrazine electrochemical analyzer shall be designed and built by the contractor.

The contractor shall design and build a portable hydrazine electrochemical cell that will provide sensitivity to better than 0.1 PPMV hydrazine, MMH and UDMH. Specificity will be maximized by selection of electrolyte, electrode system, composition, and potential and by air-electrolyte diffusion barrier membranes.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0004, DYNAMICS OF AIRCRAFT ACCIDENT VICTIMS - COMPUTER SIMULATION
J.M. Ballo, U.S. Dept. of Defense, Armed Forces Inst. of Pathology, *c/o Walter Reed Medical Ctr., Washington, District of Columbia* 20306 (DA0B6608)

Computer simulation of the kinematics of occupants in selected aircraft accidents in order to recreate the sequences of injuries and to determine their specific cause(s). This will lead to an increased understanding of the pathogenesis of such injuries and lead to more effective means of preventing them. Examine feasibility of running concurrently the crash vehicle impact simulation code so as to enhance the realism of occupant-vehicle interaction.

Operate the CALSPAN three-dimensional program as a model using selected aero-space pathology division cases as sources of input data. Correlate the actual injuries observed at autopsy with the injuries predicted from the occupant kinematics of the computer simulation. Use the optimal output features of the CALSPAN code, using subroutines to calculate injury severity indices and time points of maximum injury.

SUPPORTED BY U.S. Dept. of Defense, Army, Medical Research & Development Command

6.0005, NAVY ENVIRONMENT - DYNAMIC RESPONSE OF HUMAN HEAD AND NECK TO IMPACT ACCELERATION
R. Thorpe, Q E I Inc., *119 the Great Rd., Bedford, Massachusetts* 01730 (DN875201; N00014-78-C-0121)

The design of safety devices for pilots of fixed wing and rotary wing aircraft is dependent on our understanding of the response of the human body to extreme acceleration and impact forces. THSI research will assist in establishing this dynamic response of the human body to acceleration and impact forces.

The principal investigator will reduce and analyze the large amount of data on 3-D head-neck and torso response to impact acceleration that is being collected at the Naval Aerospace Medical Research Laboratory, Detachment, New Orleans. Inertial sensor data, physiological data and sled data will be digitized and normalized to standard conditions and analysis performed on this data for application in dynamic response models. The principal investigator will also participate in experimental protocol planning and formation to provide analytical rationale for experimental procedures.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

6.0006, NUTRITIONAL EDUCATION - A BASIC NUTRITION COURSE FOR AIR FORCE PERSONNEL
O. Maller, U.S. Dept. of Defense, Army, Natick Research & Development Command, *Natick, Massachusetts* 01760 (DA0H4364)

To develop and evaluate a prototyppic basic nutrition education course designed for AF personnel to be used in basic training, flight training programs and base level nutrition. This course should be designed so as to be of use for the Reserve, National Guard and the dependents of military personnel. The course will be directed at preventing malnutrition as a consequence of following fad diets or overnutrition by developing poor eating and activity habits.

Assess current level of nutritional knowledge and practices in a target population of AF personnel. Design and implement a program of nutritional intervention. Retest target population and appropriate control groups to evaluate efficacy of the intervention.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

6.0007, CHANGES IN THE ORGAN OF HEARING PRODUCED BY SOUND
D.J. Lim, Ohio State University, Columbus Campus, School of Medicine, Dept. of Otolaryngology, *370 W. 9th Ave., Columbus, Ohio* 43212 (DF322410; F33615-77-C-0512)

The purpose of this workunit is to examine changes in the auditory system produced by exposure to excessive sound. The effort will emphasize studies in the infra-sound (1-20 Hz) region

and long-term, low-level exposures at mid-frequencies (600-2000 Hz). Goal of the research is a reasonable hypothesis of the mechanism of injury production that provides a rationale for treatment and prevention. Results of this basic research are used in the AMRL applied technology program in establishing guidelines for limits of exposure and methods of protection from exposure to excessive sound. Ultimately this forms the basis for air force regulations governing exposure and protection criteria. Data are also used by the environmental protection agency.

Infrasound exposures will be carried out only on experimental animals. Long-term, low-level exposures will be carried out on experimental animals and human volunteer subjects at levels which do not produce permanent changes in hearing. Techniques to be employed include light and electron microscopy of inner ear structures, electrophysiological measures of middle ear muscle activity and psychoacoustic measures of changes in auditory acuity.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Aerospace Medical Research Lab.

6.0008, CONTACT AREAS OF THE FACET JOINTS OF THE PRIMATE SPINE

S.P. Combs, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF324210)

To determine the contact areas of the facet joints of rhesus monkey, baboon, and chimpanzee spines. This is to determine the anatomic position (e.g., flexion, extension) of maximum contact of the facet joints which should correspond to the position of maximum load bearing of the facet joints of the spine. The ultimate objective is to determine the position of the spine for maximum load bearing and thereby determine the best position of the spine for the ejection environment.

The cadaver spines of primates will be fitted into a testing jig allowing a multisegmental portion of the spine to be tested under an axial load in various positions (e.g., flexion, extension). Serial photographs will be used to measure the spine's response to the load. Three equidistance load cells on a force plate at the bottom of the jig will allow accurate measurement of the load applied and its vector. The spine will then be serially dissected removing muscles, joint capsules and ligaments. The entire specimen will then be stained using a Prussian blue dye. At the end of the experiment, the segments will be disarticulated and the areas of contact measured. The variance of the contact areas can then be correlated with the overall position of the spine. The procedure will be used for five rhesus monkey, baboon, chimpanzee spines. The information obtained will then be used for future experiments of loading of these primate spines and their response to the load.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Aerospace Medical Research Lab.

6.0009, EFFECTS OF AF PROPELLANTS AND CHEMICALS ON METABOLIC MECHANISMS

M.E. George, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF320700)

The purpose of this basic research is to identify and define those underlying physiological and biochemical mechanisms associated with the systemic toxicity of chemicals and material.

Studies on the effects of toxic, carcinogenic and mutagenic chemicals of special Air Force interest and application on metabolic pathways and mechanisms of action require use of radioactive tracers, gas and liquid chromatography coupled with mass spectrometry, and electron microscopic evaluation of cellular and subcelluar changes. The ultimate application of these fundamental mechanisms is to facilitate extrapolation of animal data to humans by selecting the most appropriate laboratory animal species which handles the compound similar to the metabolic pathways of man.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Aerospace Medical Research Lab.

6.0010, CEREBRAL O2 HUMAN PERFORMANCE

A.T. Kissen, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF322440)

The objective of this workunit is to describe and quantitate in human analogs, by invasive or non-invasive techniques, the impact of altered breathing gas environments on cerebral function/human operator performance. Applications of findings in this workunit include (a) validation and justification for use of non-invasive techniques in place of invasive procedures for subsequent human experimentation, and (b) data input to a cerebral oxygenation-operator performance model.

Accomplishment of the objective is dependent upon execution of various technology based experiments. (1) Studies involving cerebral oxygenation of non-human primates under g stress involves relatively short time sampling periods. The use of polorigraphic oxygen probe with rapid response time characteristics must be preceded by its evaluation against the standard mass spectrometer membrane. (2) Use of non-human primates on the DES in physiologic and performance related studies will require a DES animal platform modification to accommodate mass spectrometer analyzer and a performance display/data acquisition unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Aerospace Medical Research Lab.

6.0011, WEAPON DELIVERY INTERFACES FOR ADVANCED FIGHTER AIRCRAFT

P.V. Kulwicki, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321140)

Develop human engineering criteria for improved weapon delivery from advanced technology aircraft. The objective focuses on anticipating problem areas, technology transition issues and lead time constraints associated with aircrew interfaces with tactical fighter systems projected for the 1985-1995 time period. Continued liaison with other laboratory and operational organizations provides input for the planning, organization and accomplishment of exploratory studies of air to air and air to surface weapon delivery problem areas. This workunit supports multiple AFSC development goals (TW-1 through TW-6), technical need ASD/AFAL 1602-75-04(1), and formal agreements with the Air Force Avionics Laboratory and the Aeronautical Systems Division.

Program objectives are satisfied by periodic review of planning documents and related technical reports, continued liaison with other agency personnel, participation on technical advisory committees (FY78/79 examples are the Recon/Strike Evaluation Group and the Single Seat Attack Working Group), and the definition and execution of a coordinated exploratory development involving multiple work elements. A dual thrust is planned in order to- (1) continue working with AFAL on the ALL Aspect Gunsight Evaluation and the Missile Launch Envelope Projects in the area of fire control display techniques for air-to-air weaponry, and (2) develop the plan and documentation for an exploration of new techniques for display and control integration. This latter thrust builds on the results of three independent definition studies of display integration options performed under contract in FY 78. The results of these studies will be analyzed to develop the framework for an expanded successor development. The results of the dual air-to-air and air-to-surface thrusts of this workunit are planned to be merged in FY 81/82 to furnish a design criteria package applicable to future tactical systems, such as the enhanced tactical fighter.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Aerospace Medical Research Lab.

6.0012, PARAMETRIC ANALYSIS OF PHYSIOLOGIC DETERMINANTS IN PERFORMANCE/ACCELERATION

J.H. Veghte, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF326350)

This task is to: 1. Define the physiologic basis of performance changes associated with accelerative forces. 2. Develop and evaluate workload, biodynamic and protection models of pilot performance. 3. Devise methods of performance enhance-

ment from these models. 4. Establish parametric values of the human optimal control model in terms of visual information, observation and neuromuscular noise and the energetic stores. 5. Conceive and evaluate new analytic tools and methods that advance the understanding of the physiological basis of performance degradation during acceleration.

Efforts will be directed towards implementing experimental programs to validate the submodels delineating the effects of acceleration on performance and decision models. Initial studies will be concerned with describing the visual and other submodel transfer functions. The proprioceptor-muscular submodel will be described through electromyography techniques. Data obtained to develop the biodynamic-physiological models will be used to further describe the perception and control output models. Supportive non-human primate studies will be used to obtain necessary invasive physiologic data for the development of the models.

SUPPORTED BY U.S. Dept. of Defense, Aerospace Medical Research Lab., Biodynamics & Bionics Div.

6.0013, AEROSPACE BIOTECHNOLOGY RESEARCH SERVICES

J. Militello, University of Dayton, Research Inst., *300 College Park Ave., Dayton, Ohio* 45469 (DF317290; F33615-78-C-0501)

Many unforeseen problems arise during the conduct of the Laboratory's R&D programs which require special and immediate assistance not available except through contract arrangements. This contract effort provides whatever expertise is necessary for rapid solution in these situations. This is an extremely cost effective method of supporting all areas of research and exploratory development of the Laboratory including biodynamics, cybernetics, environmental medicine, toxicology, human engineering and performance studies as well as related support of many af development and operational systems.

This contract provides intermittent studies, analyses, experimentation and technical services for all areas of the technical program, thereby avoiding costly delays in the Laboratory's mission activities. Tasks are fully described through the contracting officer and made on a call basis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0014, A CAPACITY-THEORETIC APPROACH TO WORKLOAD ASSESSMENT

H.A. Colle, Wright State University, School of Science & Engineering, Dept. of Psychology, *Dayton, Ohio* 45431 (DF052210; AFOSR-78-3595)

AF function - this research examines a capacity-theoretic metric which can be used for assessing workload requirements, especially within the context of aircrew operations. Deficiency - workload assessment is very difficult in cockpit activities since attentional demands made on different crew members are hard to observe and quantify. Yet good workload measures are needed to satisfy aircraft design questions and provide aircrew performance measurement for training. Objective - this research will attempt to validate a capacity-theoretic approach to measuring workload. How work contributes - the current technology for assessing workload will be advanced as a result of this effort. Better performance measures should improve R&D for aircrew training.

The principal investigator has developed quantitative approach to workload assessment which employs a fixed capacity theory of attentional demand where each person has a maximal amount of processing resources which can be distributed among the tasks to be performed. Some work completed by the investigator during an AFOSR summer faculty program using performance operator curves suggests that the assumption of fixed capacity is a valid one. This research will test that assumption further in its general form using visual memory classification, paced auditory digit-shadowing, and digit-adding tasks in a dual-task paradigm.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0015, ESTABLISHING PERCEPTUAL/PSYCHOMOTOR ABILITY REQUIREMENTS

A. Siegel, Applied Psychological Services Inc., *404 E. Lancaster Ave., Wayne, Pennsylvania* 19087 (DF233320; F33615-78-C-0032)

This contract would provide for the systematic assessment of perceptual/psychomotor ability requirements in a selected sample of Air Force specialties and for the development of supporting methodologies to extend or update the evaluation process as necessary for operational purposes. Information of this type is important for directing the course of future personnel test development, establishing differential aptitude requirements and providing a useful data base for generalizing to new or modified occupational specialties.

A task level survey approach would be taken initially to capitalize on potential interface with the CODAP system. Various data collection and analysis procedures will be explored to determine the most accurate and cost-effective means for establishing such requirements. Alternate sources of information regarding specific tasks would also be evaluated including data supplied by job incumbents, supervisors and/or expert job analysts. The contractor would be responsible for all phases of the research including but not limited to a literature review and assessment of the current state of the art, development of a career field/task target list, base sampling plan, and specifications for data collection, analysis and evaluation. Approximately 40 specialties would be sampled in this exploratory effort.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0016, PSYCHO-PHYSIOLOGICAL CRITERIA FOR ASSESSMENT OF NAVAL AIRCREW PROTECTIVE EQUIPMENT

M.M. Cohen, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN581100)

To establish appropriate physiological, behavioral, and biomedical specifications and criteria for the design, development, testing, and evaluation of protective and survival aircrew equipment. Requirements for this work have been delineated in the Naval Aviation Biomedicine/Human Effectiveness Technical Workshop Report of FY-1979. This work supports work unit PM601 accession number DN581100.

Existing data concerning the adequacy and safety of protective equipment are reviewed and complemented by in-house research studies. Physiological, behavioral, and biomedical specifications and criteria for the design and development of future life support and protective equipment are established. Medical and scientific assistance is provided to establish test protocol and safety procedures for the evaluation of prototype protective equipment. This assistance includes medical monitoring of volunteer human subjects, pre- and post-test medical examinations, medical and psychophysiological evaluations of test results, and, where applicable, suggestion for subsequent improvement of the biomedical and psychophysiological adequacy of systems.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Medical Research Inst.

6.0017, REPEATED ACCELERATION EXPOSURE EFFECTS

E. Hendler, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN881086)

To determine the psychophysiological effects of repeated exposures to acceleration loads, as applied by the dynamic flight simulator (DFS) to volunteer human subjects.

Volunteer subjects shall be repeatedly exposed to predetermined levels patterns and durations of acceleration loads using the DFS. Time between successive exposures shall vary from fractions of a minute to hours. Exposures shall be made on relaxed subjects as well as on subjects protected from acceleration effects (i.e., through the use of the anti-g suit M1 starting maneuver and reclined seat). Physiological and performance measures as well as clinical assessments shall be made before during and after acceleration exposures.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

6.0018, AIR-TO-AIR TARGET ACQUISITION- FACTORS AND MEANS OF IMPROVEMENT

H.L. Snyder, Texas A & M Research Foundation, *Faculty Exchange Box H, College Station, Texas* 77843 (DF324940)

To filter the vast literature on target detection to obtain only the pertinent references on air-to-air visual acquisition. To determine the major human and physiological factors involved in acquisition. To determine which factors can be improved through training or aids. To outline a program designed to address specific and general questions which bear directly on acquisition. To prioritize these questions as to value and as to probability of success.

Task Virginia Polytechnic Institute and State University to fulfill the stated objectives through an academic research in biotechnology contract with the Southeast Center for Electrical Engineering Education.

SUPPORTED BY U.S. Dept. of Defense, School of Aerospace Medicine, Clinical Sciences Div.

6.0019, DEVELOPMENT OF IMPROVED METHODS FOR PREDICTING INVOLUNTARY SEPARATION

C.D. Gott, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Brooks Air Force Base, San Antonio, Texas* 78235 (DF233340)

To develop improved mathematical/statistical methods for predicting involuntary separation within the Air Force enlisted force and other success/fail criteria such as graduation/elimination from undergraduate pilot training (UPT), technical training, and basic military training (BMT). Generalize the resulting mathematical prediction system to improve predictability in other areas of the personnel system. Compare and evaluate the predictability of the motivational attrition prediction (MAP) model with other existing and/or newly developed prediction systems.

The MAP prediction model will be implemented and tested on AFHRL's UNIVAC 1108 computer system. The original data base used by AFMPC/DPMYAA in developing MAP will be used by AFHRL to assure error-free implementation by duplicating the original study for which MAP was developed. Other already operational prediction systems and/or modified and improved new systems will be implemented and tested. For comparison purposes, the data base of approximately 15,000 recruits entering the Air Force in 1972 will be used. For this data base, the necessary predictor variables, such as history opinion inventory (HOI), aptitude scores, high school courses, demographic information, and attrition criterion data are already available. The final optimum prediction model will be used to generalize to prediction of other success/fail-type binary and/or categorical criteria. Milestones were--Dec 77, implementation of MAP on U1100 computer system. Mar 78, reanalysis of 1972 AF accession data using MAP and other existing and/or modified prediction systems to arrive at the system with the optimum predictability. Jun 78, technical report comparison of multiple linear regression and MAP for prediction of involuntary separation. Apr 79, completion of systematic study to generalize to prediction of other success/fail criteria. Dec 79, technical report.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0020, CLINICAL STUDY GROUPS/CARDIOVASCULAR CRITERIA FOR AIRCREW SELECTION AND RETENTION

D. Hickman, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF321590)

Minimize the number of flyers who must be grounded because of the presence of circulatory and respiratory disease. It will be necessary that the significance of the abnormal response to testing procedures in regard to flying performance and safety be better quantified. This effort will accomplish this by establishing the functional and prognostic nature of abnormalities through long-term followup employing newly developed measurement techniques.

Approaches will be developed to allow more precise evaluation of cardiovascular functional integrity and capability in the presence of abnormalities to allow retention of more crewmen in flying duties than previously possible. Techniques will be developed to improve the ability to detect potential problematic disease earlier and permit a more productive preventive approach. Longitudinal studies to assess the significance of disease in aerospace operations coupled with the intensive study of patient groups with specific problems (e.g., acquired bundle branch block) will yield definitive information to help formulate or modify medical standards for aircrew selection and retention. Work was formerly documented under workunit 7755-01-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0021, ENHANCEMENT OF AIRCREW PERFORMANCE BY OPTICAL EQUIPMENT

B. Kislin, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF321970)

Optical devices have the potential to enhance flight crew performance and/or facilitate inflight procedures. In order to insure that AF aircrew are provided with optical aids which can optimize their performance, development and testing of visual devices will be on a continuous basis.

The USAFSAM will respond to operational problems identified from the field for development assistance and/or in planned research efforts where a long-standing need may exist. Filter enhancement for target detection, multifocals designed specifically for cockpit use, and new spectacle frame developments in new plastic materials will be studied. Efforts under this workunit were previously documented as workunit 7755-09-03.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0022, MICROWAVE EFFECTS

T.J. Tredici, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF323050)

The objective of this unit is to provide detailed initial ophthalmologic evaluation and follow-up, as clinically indicated, for those USAF personnel who have suffered a microwave overexposure, i.e., normally those calculated to have been exposed to greater than twice the permissible exposure limit (PEL). This work is further directed by Air Force Regulation 161-9. Finally, attention will be focused on the presence or absence of lenticular lesions and their possible causal relation to the microwave exposure.

Patients will be evaluated in the ophthalmology branch, clinical sciences division, following standard patient evaluation protocols. Follow-up over time will be established on an individual basis and reports will be made to the referring physician and medical facility. When sufficient data have been accumulated, scientific publication of the material will be made in scientific journals. Work was formerly documented under workunit 77550905.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0023, DEVELOPMENT OF OCULOMOTOR FLYING SKILLS

D. Regan, Dalhousie University, *Halifax, Nova Scotia, Canada* B3H 4H7 (DF053390; AFOSR-78-3711)

AF function - this research supports AF flying training programs, especially air operations which are predominantly visually oriented. Deficiency - aircrew training in visual simulators has not taken advantage of current knowledge about oculomotor skills. There are several areas where properties of the eye which are important to flying could be improved by specifically designed visual stimuli. Objective -this research will explore the channel theory of vision to describe channels specifically sensitive to dynamic stimulus parameters which should be important for flying skills. Experiments will be conducted to see which of these sensitives can be improved by training procedures. How research contributes - the knowledge gained from this research will impact the design of visual simulator systems, visual scene content, and instructional techniques. It appears especially appli-

cable to flying tasks which are predominantly visual in nature, such as air combat maneuvering and air-to-ground weapons delivery.

Psychophysical methods will be used to describe the properties of information-processing channels in the human visual system that are preferentially sensitive to motion and to dynamic stimulus parameters. Civilian subjects will be studied to determine the range in sensitivities of each channel. These sensitivities will be compared to test results of experienced Air Force pilots to see what channels appear to be most developed in aviators. This data will be collected at USAF bases by a field researcher with portable equipment. Once the oculomotor skills critical for piloting have been identified, training procedures such as simple visual exercises will be developed to see if these skills can be improved in pilots.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, AERONAUTICAL RESEARCH, TECH AREA IV-RESEARCH IN MATHEMATICS

I.C. Statler, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Aeromechanics Lab., *Moffett Field, California* 94035 (DA0C5004)

The objectives are to exploit and apply state-of-the-art mathematics in support of laboratory research efforts - to develop a technology base in numerical analysis and computational techniques - and to advance mathematics in areas of rotary-wing fluid mechanics applicable to airmobile R&D.

The approach consists of three major steps - (1) maintain awareness of the development and disseminate state-of-the-art mathematics throughout the laboratory - (2) exploit new techniques and methods for assisilating the results of complex, time-dependent computations for airmobile applications - (3) conduct research in various applied mathematical topics which are relevant to Army needs. These objectives will be achieved largely through joint participation with NASA making maximum use of the facilities and expertise available within NASA with respect to computational fluid dynamics.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Aeromechanics Lab.

7.0002, DISPERSION MODELING

R.S. Coffey, N U S Corp., *4 Research Pl., Rockville, Maryland* 20850 (2320; EN-77-C-02-4290)

The objective is to develop mathematical models to predict the dispersion characteristics of nuclear fuels uses in the space power program in the atmosphere, lithosphere and hydrosphere. Data generated in the laboratory which demonstrate the behavior of nuclear fuels in the environment are modeled mathematically. These models are used to statistically evaluate the risk of using space power systems.

SUPPORTED BY U.S. Dept. of Energy, Office of Policy & Evaluation, Office of Nuclear Energy

7.0003, WAVES IN TURBULENT MEDIA AND RANDOM LINEAR HYPERBOLIC SYSTEMS 15452-M

P.L. Chow, Wayne State University, School of Liberal Arts, Dept. of Mathematics, *4841 Cass Ave., Detroit, Michigan* 48202 (DA0F9164; DAAG29-78-G-0042)

To study wave propagation in time-dependent random media with special stress on effects of turbulence on the statistical properties of wave parameters. Relevance: Study of time-dependent wave propagation is of practical importance to radio and optical communications systems. Specifically, the proposed work may provide better quantitative tools for measuring wave propagation of radio waves in the ionosphere and pulsed laser beams through the atmosphere.

Develop asymptotic and approximate methods for random partial differential equations.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

7.0004, PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATION TO WAVES, SCATTERING AND TRANSONIC FLOW

C.S. Morawetz, New York University, Courant Inst. of Mathematical Sciences, *251 Mercer St., New York, New York* 10012 (DN123460; N00014-76-C-0439)

This research is concerned with a number of mathematical problems from fluid dynamics which arise in the design of Navy vehicles and in surveillance. Of particular interest are the problems of scattering and transonic flow.

Research is to be done in the mathematical theory of partial differential equations. Particular attention will be focused on waves, scattering and transonic flow. Inverse problems related to the time dependent wave equation will also be investigated as will certain free boundary problems.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

7.0005, CONTINUUM THEORY OF FRACTURE

M.E. Gurtin, Carnegie Mellon University, Mellon College of Science, Dept. of Mathematics, *4400 5th Ave., Pittsburgh, Pennsylvania* 15213 (DF043720; AFOSR-76-3013)

AF function - damage tolerance of advanced aerospace vehicles is essential to reductions in AF cost of ownership. Deficiency - new failure criteria are needed to accurately predict the fracture process under a wide range of materials (metals and composites) and environmental states. Objective - the objective of this research is to investigate new fracture theories for metallic structures and to apply continuum mechanics based upon basic energy balance considerations and diffusion to the durability of composites. How work contributes -research contributes to improved failure resistant designs for aircraft and solid propulsion vehicles.

Principal investigator is approaching the fracture problem as a rational treatment of energy balance. The energy of the fracture surface should be treated as a loss in binding energy caused by the creation of new fracture surfaces. Consideration will be given to the propagation of the fracture surfaces and the effects of temperature. Moisture absorption will continue to be investigated as a diffusion process in a deforming solid. Both moisture and temperature considerations will be included in the study. The influence of free and bound states of moisture in the solid will be studied, as well as interfacial diffusion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, BEAM-FOIL EXPERIMENTS WITH HEAVY IONS

S. Bashkin, University of Arizona, School of Liberal Arts, Dept. of Physics, *Tucson, Arizona* 85721 (PHY80-15680)

This research utilizes the technique of beam foil spectroscopy to continue mean lifetime and spectral measurements on bromine, krypton, iodine, and xenon in their various states of ionization. These measurements will provide data of use for fusion research. The group also proposes investigations and improvements in the use of ethylene discharge generated foils.

This is a 1-year terminal award previously supported under NSF grant PHY78-09138A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0002, STUDY OF SOLAR OSCILLATIONS

H.A. Hill, University of Arizona, School of Liberal Arts, Dept. of Physics, *Tucson, Arizona* 85721 (DF057050; AFOSR-80-0049)

AF function - USAF long range communication, surveillance, navigation and detection systems are affected by the ionized environment in near-earth space. This environment is maintained by radiation from the sun and particles from the solar wind and changes in response to solar activity. Deficiency - standard theory of stellar evolution cannot predict the observed properties of the sun, such as radius, photon and neutrino luminosity and surface rotation rate. Objective - to study the internal structure of the sun by measuring and classifying solar oscillations. Contribution - normal modes of solar oscillations can become a diagnostic probe to provide information about the interior of the sun.

An observational and theoretical program will classify the normal modes of vibration of the sun and use the results to study the sun's internal radial structure and rotation. Observations will be made with improved frequency resolution by using continuous data sets over periods of weeks. The surface harmonic structure will be studied by making simultaneous observation of multiple solar diameters and by using techniques to define the position of the solar limb. Rotational splitting of the modes as an indicator of the internal rotation rate will be studied by observing beats in the power of a particular peak or directly by mode identification schemes. A theoretical study will be conducted on boundary conditions used in solar and stellar pulsation calculations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0003, ACQUISITION OF LOW TEMPERATURE CLOSED CYCLE REFRIGERATOR SYSTEM

J.A. Davis, California State University & Colleges, San Diego State University, School of Sciences, Dept. of Physics, *5402 College Ave., San Diego, California* 92115 (CDP79-23566)

The award makes possible acquisition of a closed cycle cryostat system capable of operating temperatures of 10-300 degrees K and will permit several research projects to be extended. These programs include: 1. Measurement of the temperature dependence of acoustoelectric amplification of high frequency sound in semiconductors. (Dr. Jeffery Davis). Measurement of the effects of high magnetic fields on the hydrogenic energy levels of donors in semiconductors. (Dr. Davis). Cyclotron resonance studies in semiconductors in high magnetic fields at infrared wavelengths. (Dr. Davis). Self-diffusion in orientationally-disordered crystals using NMR techniques. (Dr. Lowell Burnett). Intramolecular vibrational relaxation studies using Raman spectroscopy. (Dr. Jerry E. Solomon).

SUPPORTED BY U.S. National Science Foundation, Office of Planning & Resources Management, Div. of Budget & Program Analysis

8.0004, SOME AERONOMIC PROBLEMS IN PHOTODISSOCIATION, PHOTOABSORPTION, AND ENERGY TRANSFER

T.G. Slanger, S R I International, Molecular Physics Center, *333 Ravenswood Ave., Menlo Park, California* 94025 (ATM78-07605)

This grant supports basic laboratory studies of molecular processes of importance to Earth's atmosphere. Using a pulsed 1610 A H2 laser as a light source the basic common O (1D) plus 2 energy transfer reaction will be investigated in unprecedented but needed detail. Specifically the kinetics and temperature parameters of this reaction will be determined. The same systems will also be used to measure the rate of the aeronomically important coefficients for quenching O(1D) and O2(b1 sigma g plus) v equals n states by ground state oxygen atoms, processes that may be of considerable atmospheric importance. The laser will also be used to measure O(1D) yields from various aeronomically important triatomic molecules at 1610 A.

Studies will be extended of the atomic products following photodissociation in O2 in the wavelength region below the Schumann-Runge continuum with emphasis on fine structure appearing in the O2 absorption spectrum below 1200 A. The extent of predissociation in the several states of NO, accessible from the ground state at absorption wavelengths between 1500 and 1900 A, will also be measured.

Absorption spectra of the common atmospheric gases are not generally available at elevated temperatures; at 1000 degrees K, calculations show that gases may easily have absorption cross sections three times larger than at 300 K. Such an effect would have considerable impact on modeling calculations, and measurements will be made on all the common atmospheric gases between 1050 A and 2000 A, at temperatures up to 1000 K.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

8.0005, INVESTIGATE THE LIMITATIONS AND CAPABILITIES OF HIGH ENERGY, LOW GAMMA, ION BEAM PROPAGATION

R.R. Johnston, Science Applications Inc., *P.O. Box 10268, Palo Alto, California* 94303 (DN975378; N00014-79-C-0221)

The Navy needs quantitative information on the propagation of intense, high energy, low gamma, ion beams in resistive gaseous and plasma media. New sources for such beams are being currently developed. The need for such development hinges, in good part, on the ability of the ion beams thus produced to propagate over long distances in resistive and gaseous plasma media.

The propagation phenomena will be modeled in terms of the monopole and dipole plasma-electrodynamic interaction. A multi-fluid description will be incorporated in a computer simulation code LOGAP. Finite temperature and pressure will be included to establish realistic predictions on the longitudinal bunching instability.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0006, PSEUDOPOTENTIAL METHODS IN PHYSICS

W.A. Harrison, Stanford University, Graduate School, Dept. of Applied Science, *Stanford, California* 94305 (DMR77-21384)

This is a continuation of research previously supported under DMR-7302351. Theory relating the electronic structure of solids to the dielectric and bonding properties of those solids will be developed. A systematic set of matrix elements for transition-metal solids, analogous to those for simple solids, will be derived from the known electronic structure of a number of such systems. Calculations of various properties will be carried out in terms of these parameters. Also, elementary LCAO theory will be applied to covalent and ionic solids.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0007, LASER ANNEALING OF SILICON ON SAPPHIRE (SOS) FILMS

R.N. Reedy, U.S. Dept. of Defense, Navy, Naval Ocean Systems Center, Electronics Engineering & Sciences Dept., *San Diego, California* 92152 (DN988538)

The technical objective of the program is to generate thin (0.2 -0.3 micron) silicon-on-sapphire (SOS) films with carrier mobilities currently available only in much thicker films (0.5 micron)these thin SOS films will be utilized for fabrication of high performance MOS circuitry.

The approach will be to utilize laser annealing and ion implantation to improve the quality of SOS films. The major thrust will be to create a buried amorphous layer by means of channelized ion implantation and then to use laser annealing to recrystallize the silicon from the surface by means of solid state

epitaxial regrowth. The upper surface would then be stripped back, yielding a high quality thin SOS film. Variations of the application of laser annealing will be investigated further, and pursued as appropriate. MOS test devices will be designed, fabricated and evaluated.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0008, COMMUNICATIONS - MAGNETIC ALLOYS AND ORGANIC CONDUCTORS

R. Orbach, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (DN123150; N00014-75-C-0245)

This work involves the development and analysis of new classes of materials for usage in display devices, magnetic amplifiers, electronic circuits, and information storage AIN naval systems in surveillance and communications.

Energy transport in disordered systems will be studied; an experimental study of the dynamics of spin glasses, properties of granular superconductors and superconducting response times. Theoretical studies will be carried out on nematic polymers, colloidal crystals, unsaturated polyelectrolytes and phospholipid monolayers.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0009, GENERAL RELATIVITY AND RELATIVISTIC ASTROPHYSICS

J.B. Hartle, University of California, Santa Barbara Campus, School of Letters & Science, Dept. of Physics, *Santa Barbara, California* 93106 (PHY78-09620)

Research in gravitation theory supported under NSF Grant PHY76-08551 A01 will be continued. Among the topics to be investigated are: 1) Particle production in the early universe: This process is the most promising mechanism to explain the large scale homogeneity and isotropy of the universe, and the observed photon to baryon ratio. 2) Black holes and gravitational collapse: They may explain the enormous energies necessary for the activity of quasars and galactic nuclei. 3) Relativistic stellar structures: Studies will concentrate on the possible end states of stellar and galactic evolution associated with rapidly rotating objects.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0010, ATMOSPHERIC MEASUREMENTS USING LASER TEC

S. Chiao Yao, Colorado State University, School of Natural Sciences, Dept. of Physics, *Fort Collins, Colorado* 80523 (DN880112; N00014-78-0289)

This contract will provide further development in (a) the single-particle correlated laser doppler velocimeter (LDV) and (b) the laser time-of-flight velocimeter (LTV) for remote sensing of the atmosphere. Specific tasks are (I) to conduct experiments for the evaluation of the concept and potential of the single particle correlation for remote wind speed sensing. (II) to develop techniques for overall aerosol concentration and size distribution measurements. (III) to develop a automated LDV and LTV systems for daytime use. (IV) to invesigate the possibility of obtaining new information of atmospheric turbulence in a short time scale of the order of milliseconds.

To extend the existing techniques of single-particle correlation LDV and the laser time-of-flight velocimeter at the Colorado State University for the simultaneous assessment of the wind speed and the aerosol concentration in the atmosphere. In situ particle sizing will be done by a two-angle intensity-ratio particle sizing spectrometer. Instrument development and evaluation, field experiments are to be emphasized.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0011, MAGNETIC CRYSTALS WITH WEAK INTERACTIONS

W.P. Wolf, Yale University, School of Engineering, Dept. of Engineering & Applied Science, *206 Elm, New Haven, Connecticut* 06520 (DMR79-18175)

Experimental research on magnetic phenomena in solids and new magnetic materials previously funded by DMR-7623102 will be continued and extended. The work covers several related areas: 1) Experimental studies of tricritical and wing critical points using light scattering, neutron scattering and magnetothermal techniques. 2) Magnetic and thermal properties of mixed crystals, including ferromagnetic-antiferromagnetic and antiferromagnetic-diamagnetic systems. 3) Radiofrequency susceptibility studies of spin-spin interactions. 4) Development of a semi-automatic calorimeter for use in specific heat studies of magnetic phase transitions and related magneto-thermal properties. 5) Magnetic studies of some quasi one- and two-dimensional systems. 6) Development of improved methods for preparing and characterizing new magnetic materials using high pressure hydrothermal and coprecipitation techniques. 7) Theoretical studies of various models designed to simulate magnetic materials investigated in these and earlier experimental work.

The principal objective of all these studies is to seek direct conformation between theory and experiment, with a view to improving our understanding of the microscopic processes important in magnetic materials.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0012, PHYSICAL PROPERTIES OF IR SEMICONDUCTOR MATERIALS

E.D. Palik, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN620098)

To obtain a basic knowledge of the physics and chemistry of semiconductor materials particularly those aspects important in the development and characterization of materials needed for high performance and/or less expensive electronic devices and components. To investigate the bulk, surface, and thin film optical and electronic properties of a number of semiconductors for possible infrared and microwave device applications. To study the interaction of electromagnetic radiation and semiconductor materials.

Surface and interface properties, lattice-vibration parameters and electronic band structure are studied with a variety of optical techniques. Optical reflection, transmission, and emission are the primary experimental approaches.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0013, NUCLEAR REACTIONS AND STRUCTURE

J.D. Fox, State University System of Florida, Florida State University, School of Arts & Sciences, Dept. of Physics, *205 Wildwood Dr., Tallahassee, Florida* 32306 (PHY80-05174)

This grant will support a nuclear science research program at the Florida State Univesity Tandem Van de Graaff Laboratory. The research is concentrated into three main areas: heavy ion resonances, nuclear spectroscopy, and heavy ion reaction mechanisms. The 8Be detector especially suited for measurements at 0 degrees will be used for initial surveys. Time-of-flight techniques will become important when beam pulsing becomes available and will be applied to problems of ejectile mass identification and neutron energy measurement. Several problems in nuclear spectroscopy will be investigated. Heavy ion induced reactions and gamma-ray detection techniques will be used for studies of the spectroscopy of light nuclei and nuclei of intermediate mass. Nuclear reaction mechanisms of heavy ions also will be investigated.

This work is a continuation of a research program previously supported under NSF grant PHY78-11560A01. This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0014, REACTIONS AND TRANSPORT PROPERTIES OF ATMOSPHERIC IONS

E.W. McDaniel, Georgia Inst. of Technology, School of Physics, *225 North Ave. N.W., Atlanta, Georgia* 30332 (ATM79-06109 A01)

A supplement to existing Grant ATM-7906109 permits Earl W. McDaniel to attend the Sixth International Conference on Atmospheric Electricity in Manchester, England, during the period July 28 through August 1, 1980. He will deliver a 45-minute talk at this conference on 'Ionic Transport Phenomena and Their Application to Atmospheric Problems.'

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

8.0015, ANGLE RESOLVED PHOTOEMISSION STUDIES OF SOLID SURFACES AND OVERLAYERS USING SYNCHROTRON RADIATION

Z. Hurych, Northern Illinois University, School of Liberal Arts & Sciences, Dept. of Physics, *DeKalb, Illinois* 60115 (DMR78-11663)

The experimental research program to study the electronic structure of solids, surfaces and interfaces by means of Ultraviolet Photoemission Spectroscopy (UPS) using synchrotron radiation which previously was supported by NSF grant DMR-7616436 A01 will be continued. The experimental studies will focus on two research areas. The first includes problems related to bulk as well as surface electronic structures of the layered semiconductor Bi2Te3 (both clean and with adsorbate), and calculation of the angular patterns that would ascertain the relative role of single (Bragg) and multiple scattering in the photoemission process. Also surface and bulk properties of selected sodium tungsten bronzes will be studied. The second area, representing a new effort, will be studies of the electronic properties of ordered chalcogen overlayers adsorbed on single crystal surfaces of a series of d-band metals, Ni, Ag and Cu. Here specific advantage will be taken of an active collaborative interaction with the theoretical group of Professor S. Y. Tong (University of Wisconsin at Milwaukee). Comparison of experiments with state-of-the-art theoretical treatment should allow, by means of identification of the symmetries and locations of the bonding sites, determination of the basic properties of the chemisorptive bond.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0016, MAGNETISM IN TRANSITION-METAL ALLOYS AND RARE-EARTH COMPOUNDS

J.S. Kouve, University of Illinois, Chicago Circle Campus, School of Liberal Arts & Sciences, Dept. of Physics, *601 S. Morgan St., Chicago, Illinois* 60680 (DMR78-12777)

This is a continuation of research previously supported under DMR-7622305.

In studies of magnetic materials, one of the areas of current interest is the determination of the critical concentration of magnetic atoms, needed for the system to become magnetically ordered. In this project, specific heat measurements will be carried out in high magnetic fields in order to study and characterize local magnetic effects (magnetic clusters, paramagnons) in alloys such as Pd-Ni and Ni-Cu near their critical compositions for ferromagnetism. Similar measurements will be carried out to determine the local exchange and anisotropy fields in mictomagnetic alloys such as Cu-Mn. A further experimental study of higher order (biquadratic) exchange interactions in single crystals of selected rare-earth compounds, such as HoSB and PrAg, will be carried out.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0017, INTERDISCIPLINARY PROGRAM OF MATERIALS RESEARCH

C.P. Flynn, University of Illinois, Urbana Champaign Campus, School of Liberal Arts & Sciences, Dept. of Physics, *Urbana, Illinois* 61801 (DMR77-23999)

Major interdisciplinary programs are being pursued in three areas. The effects of structure modulation are studied in Microscopically Modulated Materials, where theoretical and experimental investigations of property variation are being carried out. Of especial interest are the effects on the fluctuations, on morphology and dynamics of phase transitions, and on the control of the resulting properties.

The program on Optical Semiconductors emphasizes the quaternary system In-Ga-As-P, in which materials exhibiting a large range of band gap width can be prepared. Such materials can be used in optical devices tuned to selected wavelength.

The program on Compound Catalysts emphasizes non-metallic catalysts, and is currently primarily concerned with the theory of surfaces. The development of instrumentation for proving the properties of clean and of doped surfaces is the initial objective.

Significant support is provided for the operation of central facilities and for additional research on liquids, on disordered solids, and on structural alloys. Close coordination with a research program core-supported by the Department of Energy is maintained locally.

This award is a continuation of DMR76-01058 A01 and is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0018, VIBRATIONAL SPECTROSCOPY

L. Kesmodel, Indiana University, Bloomington Campus, School of Arts & Sciences, Dept. of Physics, *Memorial Hall, Bloomington, Indiana* 47401 (DN075055; N00014-80-C-0147)

This research will clarify the vibrational modes of molecules adsorbed on surfaces, and thus improve the Navy's ability to handle problems in catalysis, corrosion, semiconductor, and energy conversion.

Electron-energy-loss-spectroscopy will be used to study the vibration of molecules on surfaces. This will clarify both the molecular species adsorbed and the bonding position of the molecule.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0019, VACUUM DEPOSITED POLYCRYSTALLINE SILICON FILMS FOR SOLAR CELL APPLICATIONS

C. Feldman, Johns Hopkins University, Applied Physics Lab., *Johns Hopkins Rd., Laurel, Maryland* 20810 (ZT40; ET-78-A-03-2208)

The objective is to develop methods for fabricating and doping thin polycrystalline silicon films with controllable structural and electronic properties using vacuum deposition techniques. Emphasis will be placed on developing procedures and using materials that will be compatible with low-cost solar cell production. Special care will be taken to understand and minimize grain boundary losses. The approach involves preparing vacuum deposited polycrystalline silicon films on various kinds of substrates with and without back electrodes, and investigating effects of material purity, doping procedures, substrates, deposition parameters, etc., on crystalline growth, grain boundaries, silicon layer characteristics and photovoltaic response. It is expected to advance understanding of polycrystalline silicon thin film photovoltaics; develop vacuum deposition processes suitable for production of large-grained, doped, polycrystalline silicon films; and determine whether the investigated materials and fabrication procedures are suitable for low-cost production of 10% efficient solar cells.

SUPPORTED BY U.S. Dept. of Energy, Div. of Solar Technology

8.0020, ELEMENTARY PARTICLE THEORY AND QUANTUM FIELD THEORY
O.W. Greenberg, University of Maryland, College Park Campus, School of Arts & Sciences, Dept. of Physics, *College Park, Maryland* 20742 (PHY80-07289)

Research will be done in theoretical physics to enhance our understanding of the elementary particles. The investigators are developing non-perturbative methods of calculation for quantum field theories; in particular for bound states with separable or with permanently confined constituents. They will apply these techniques to the calculation of baryon magnetic moments, to the derivation of the nucleon-nucleon potential from quantum chromodynamics, and to the problem of permanent quark confinement. They are investigating theoretical schemes which avoid color-analog van der Waals forces between separate hadrons, as well as phenomenological consequences of such schemes. They will study the impact of the necessity of the string-gluon degree of freedom upon the quark model. They are investigating the nature of the fundamental degrees of freedom and associated substructures underlying elementary particle physics, including the fractional vs. integral electric charges of quarks, the compositeness of quarks and/or leptons, the grand unification of quarks and leptons or of their substructures, the possible volations of baryon number, lepton number, and fermion number conservation, with emphasis on proton decay, the hierarchies of symmetry breaking, and theories of CP violation.

This is the first year of a three-year continuing grant, previously supported under NSF grant PHY76-16562 A02.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0021, ANALYTIC METHODS IN CONDENSED MATTER PHYSICS
E.P. Gross, Brandeis University, School of Arts & Sciences, Dept. of Physics, *415 South St., Waltham, Massachusetts* 02154 (DMR79-23213)

Research previously supported by DMR7602048.

The aim of the research is to develop and improve mathematical approximation schemes useful in condensed matter physics, many body theory, and in the study of particle-field, random potential and polymer problems.

Ideas from the kinetic theory of fluids will be adapted to the properties of disordered systems. The theory consists of a set of systematic truncations for the hierarchy of correlation functions based on multiple scattering theory.

Techniques will be developed for the approximate evaluation of path integrals, and applied to the study of particles and waves subject to random potentials, and to polymer excluded volume problems.

The theory of polaron type Hamiltonians will be developed. The aim is to find a systematic theory for the strong and intermediate coupling domains comparable to the existing systematic theory for weak coupling. Path integrals will be used and the connection with methods developed in recent quantum field theory approaches to extended and deformable objects will be studied.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0022, SPIN POLARIZED TUNNELING TECHNIQUES FOR THE STUDY OF FERROMAGNETIC CRYSTALS
R.H. Meservey, Massachusetts Inst. of Technology, Francis Bitter National Magnet Lab., *170 Albany St., Cambridge, Massachusetts* 02139 (DMR79-10047)

This research is directed to the development of electron spin polarized tunneling techniques and their application to the study of ferromagnetic metal crystals. In the initial phase of this research, equipment, facilities, and techniques were developed to the point where a few high quality tunnel junctions were formed on single crystal Ni surfaces. From these junctions, preliminary values of the spin polarization of tunnel currents from the (110) and (100) faces of Ni were obtained. More importantly, it was demonstrated for the first time that such measurements were actually feasible. In the next stage, the Ni surfaces will be characterized with analytical techniques such as electron microscopy, Auger spectroscopy, and low energy electron diffraction. The characteristics of the crystal surface, tunnel barrier, and the superconducting counter-electrode will be improved to increase the yield of good junctions. Finally, the method will be applied to the study of several ferromagnetic metals. Such measurements which probe the spin polarization of conduction electrons should give fundamental information on the nature of ferromagnetism in metals.

This is the first year of a three-year continuing grant.

This is a continuation of research previously supported by NSF Grant No. DMR-7611119.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0023, RADIO OBSERVATIONS OF INTERSTELLAR MOLECULES
A.H. Barrett, Massachusetts Inst. of Technology, School of Science, Dept. of Physics, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (AST79-25075)

Radio astronomical observations of interstellar molecular lines will be made toward nearby dark clouds, toward molecular clouds throughout the galactic plane, and toward stars with extended circumstellar shells. The nearest dark cloud regions will be observed in lines of carbon monoxide (CO), ammonia (NH3) cyanoacetylene (HC3N) and cyanodiacetylene (HC5N) in order to find more small, dense fragments masses approximately the mass of the sun, and to study their motions and stability. Dark clouds with reflection nebulae will be studied in lines of CO, NH3, and H2O to gain information related to the interaction between the existing star(s) and the cloud. Surveys in lines of carbon monosulfide (CS) and NH3 will be made along parts of the galactic plane, to study the distribution and properties of the densest molecular clouds. A search will be made for emission by circumstellar methane at 13 GHz. Improvements will be made in radiometers operating at wavelengths near one centimeter and 6 millimeters for line observations of HC3N formaldehyde (H2CO), NH3, and CS. These radiometers will be available to other users of Haystack Observatory in northeast Massachusetts.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

8.0024, THE ELECTRON G-FACTOR ANOMALY AND RELATED EXPERIMENTS
A. Rich, University of Michigan, Ann Arbor Campus, School of Literature Science & the Arts, Dept. of Physics, *Ann Arbor, Michigan* 48104 (PHY77-26037)

This experiment uses the techniques of precise atomic metrology to measure a key fundamental property of an elementary particle (the electron) and its anti-particle (the positron). This is the measurement of the g-factor anomaly to an accuracy of 25 parts per billion. This will be a significant test of quantum electrodynamics and other fundamental physical theories. The method used is an extension of the Mott double-scattering technique. The anomaly is determined directly by observing the precision of the electron spin with respect to its velocity between the two scatterings. A number of improvements have been incorporated in the experiment.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0025, EXCITATION OF METASTABLE ATOMIC HYDROGEN BY LOW-ENERGY ELECTRONS
J.C. Zorn, University of Michigan, Ann Arbor Campus, School of Literature Science & the Arts, Dept. of Physics, *Ann Arbor, Michigan* 48104 (PHY77-18832)

This grant initiates an experiment in atomic physics to measure the differential cross section for excitation of a particular excited state (the 2 2 S 1/2 state) of atomic hydrogen by impact of low-energy electrons. The cross section for this fun-

damental collision process has been calculated many times in a variety of approximations, but there is no data on the differential cross section in the interesting energy range of 0-1.4 eV above threshold. The time-of-flight experiment used here is particularly well suited for cross section measurements in the near-threshold regime. It avoids the electron optics problems inherent in conventional cross section determinations, and it provides values of the cross section over the complete range of 0-180 degrees.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0026, ATOM-SURFACE INTERACTION

N. Tzoar, City University of New York, City College, School of Arts & Sciences, Dept. of Physics, *Convent Ave. at 138th St., New York, New York* 10031 (DN575260; N00014-75-C-0949)

Atoms adsorbed on surfaces are important to many areas of interest to the Navy, including surface reactions, adhesion, lubrication/friction/wear, and electronic devices. A new analytical tool (electron stimulated desorption) is being studied theoretically to clarify the understanding of adatom-surface interactions.

The contractor will study theoretically the phenomena of electron stimulated desorption from a surface, including the excitation process, the dynamics of desorption, and possible deexcitation mechanisms.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0027, LASER AND OPTICAL PHYSICS 13410-P

M. Lax, City University of New York, City College, School of Liberal Arts & Sciences, Dept. of Physics, *Convent Ave. & 138th St., New York, New York* 10031 (DA0U5578; DAAG29 76 G0055)

To study (1) linear and nonlinear interaction of electromagnetic radiation with electric and magnetic polarization carrying excitations in condensed matter, (2) fluctuations in lasers and condensed matter including hydrodynamic instabilities, and (3) laser physics, including laser resonators, mode competition, light amplification. The use of interdependences between pyro, piezo, magneto, and electroptic properties of materials forms the basis for a part of electronic device technologies. The laser work is relevant to the design of high power lasers that are desired to operate in a single longitudinal mode to obtain a powerful, narrowly focused beam. The Bernard instability finds application in cloud formation in meteorology and the Rayleigh-Taylor instability is applicable to lubrication and flow over curved surfaces.

(1) A unifying LaGrangian approach is used, for both dissipative and non-dissipative phenomena, emphasizing rotational and displacement invariance in addition to usual (e.g., crystalline) symmetries. (2) Using efficient methods of calculating correlation functions for Fokker-Planck systems, study the onset of Bernard and Rayleigh-Taylor instabilities and the onset of turbulence in laminar flows induced by thermal gradients and shear forces. (3) Corrections to the paraxial approximation to the Maxwell equations are obtained and used to investigate the effects of refraction, gain saturation and diffraction in laser amplifiers.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0028, STUDIES OF IONOSPHERIC IRREGULARITIES AND PLASMA INSTABILITIES IN THE MAGNETOSPHERE

R.N. Sudan, Cornell University, Ithaca Campus, Lab. of Plasma Studies, *159 Sapsucker Woods Rd., Ithaca, New York* 14850 (DN975322; N00014-79-C-0308)

The Navy needs quantitative information on the active state of the ionosphere and magnetosphere for radio communication applications and uses. In particular, density iregularities resulting from turbulence in the ionosphere and in the aurora will be studied. The dynamics of triggered whistler emissions will also be studied.

Irregularities in the ionosphere and the aurora resulting from nonlinear interactions will be modeled in terms of a two-dimensional strong turbulence theory whose basic is the 'direct interaction approximation'. Analytical and numerical work on triggered whistler emissions will be pursued in collaboration with Professor J. Denavit.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0029, HYDROGEN ATOMS AND OTHER SIMPLE FREE RADICALS AT LOW TEMPERATURES AND AT HIGH MAGNETIC FIELDS 16239-P

D.M. Lee, Cornell University, Ithaca Campus, School of Arts & Sciences, Dept. of Physics, *Ithaca, New York* 14850 (DA0G1942)

To trap substantial concentrations of hydrogen atoms in a high magnetic field at low temperatures and then to study the quantum fluid properties by magnetic resonance techniques. Relevance. This research seeks to determine whether active species can be stabilized in sufficiently high concentrations to provide a practical means of energy storage.

High speed He3-He4 dilution refrigeration will be used to provide required low temperatures. Both electron paramagnetic resonance techniques using a far infrared laser and nuclear magnetic resonance techniques at frequencies of the order of 1GHz will be employed. Concentration and recombination rates will be studied to obtain information on low temperature reaction kinetics as well as to test various wall coatings designed to inhibit surface recombination. A 90 kilogauss high homogeneity magnet will be used to trap and maintain an aggregate of H atoms in a given spin state as well as to provide the steady field for magnetic resonance.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0030, MULTIPLE X-RAY DIFFRACTION EFFECTS IN SINGLE CRYSTALS

B. Post, Polytechnic Inst. of New York, Brooklyn Campus, School of Science & Engineering, Dept. of Physics, *333 Jay St., Brooklyn, New York* 11201 (DMR79-20419)

It has been shown by the Principal Investigator that information about the phases of X-ray reflections, which are lost in conventional two-beam diffraction, can be extracted from the intensities of the reflections under conditions of simultaneous three-beam diffraction. This investigation is designed primarily to complete earlier work aimed at establishing criteria for optimization of the phase determination procedure for relatively imperfect crystals, such as are usually used in crystal structure analysis. Efforts will be made to extend the experimental determinations of phases to non-centrosymmetric crystals. Selected organic crystals will be used in this work. The results should provide valuable supplements to the 'direct' statistical methods now widely used in crystal structure analysis.

Two investigations involving the utilization of multiple diffraction methods for lattice parameter determination will be completed during the coming year. One involves the determination of the effects of varying dopant concentrations on the unit cell dimensions of thin epitaxial silicon films on silicon substrates. A second involves a detailed comparison of the new multiple diffraction method of lattice constant measurement with other more standard techniques.

This is a continuation of research previously supported by NSF Grant DMR-77-02532.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0031, DISPERSION FORCES OF SOLIDS UNDER STRESS 15385-P

L.C. Biedenharn, Duke University, Trinity College of Arts & Sciences, Dept. of Physics, *Durham, North Carolina* 27706 (DA0F9043; DAAG29 77 G0184)

To arrive at a realistic potential energy function for adatom-solid surface adsorption that will be valid when the

solid is under high external stresses. Relevance. The calculations are directly relevant to stress-corrosion and wear problems of the Army.

To use diagrammatic field theoretic techniques to obtain the dielectric response function as well as to use a phenomenological approach to include changes in the polarizabilities of the solid when the solid is stressed.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0032, PROPERTIES OF FLUID HELIUM NEAR CRITICAL POINT

H. Meyer, Duke University, Trinity College of Arts & Sciences, Dept. of Physics, *Durham, North Carolina* 27706 (DF046080; AFOSR-77-3119)

AF function - this proposed research primarily falls in the 5.3 research objectives which deal with electrical power for manned and unmanned aircraft, satellites and space stations as well as electrical power for unattended ground based systems. Research is required in the generation of usable electric power from non-nuclear energy sources, distribution and conditioning of the power and the attendant material requirements. The development of superconductive rotating electrical power generators and pulsed superconductive energy storage systems require that these systems be kept below their normal transition temperature. Deficiency - research is needed in making more efficient heat transport helium systems. As an example of the need, over 90 percent of the system weight of a superconductive energy storage system results from the cryogenic coolant and its storage container. This causes severe weight, volume and reliability penalties in the helium refrigeration systems. It does not appear that high temperature superconductors (TC 25 degrees k) will be developed. Objective - the program is based on high resolution dielectric constant measurements from which the pi can determine very sensitively the changes in the dielectric constant and also changes in the number density in the fluid with temperature and as a function of height in the cell. These results are used to obtain values of thermodynamic parameters of liquid helium (3) and (4) mixtures near the critical point. Contribution - this research is a part of a comprehensive program in superfluids and superconductors.

High resolution dielectric constant measurements are made to investigate thermodynamic characteristics of He(3) and He(4) mixtures near the critical point. More specifically the concentration susceptibility for a mixture ratio of .8 will be measured near the liquid vapor critical point and compared with theory. In addition the thermal diffusivity ratio, thermal conductivity and mass diffusion coefficient will be measured for concentrated mixtures near the superfluid transition. These measurements will be interesting since renormalization group theory and scaling theory predict differing behaviors.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0033, FUNDAMENTAL STUDIES IN ATOMIC COLLISIONS

J.S. Risley, University of North Carolina, North Carolina State University, School of Physical & Mathematical Sciences, Dept. of Physics, *Raleigh, North Carolina* 27607 (PHY80-09198)

This proposal is concerned with fundamental studies in atomic collisions. The experimental research direction for the next two years will be oriented toward obtaining a better understanding of molecular potential curves of the HeH plus, NeH plus and ArH plus systems, electron detachment of H minus, charge transfer of H plus, electron spectroscopy of the excited states of a variety of negative ions and charge transfer of H ion in the presence of weak electric fields.

The positions and widths for many autodetaching states of negative ions (most importantly H ion) and autoionizing states of atoms and positive ions will be made. Intensity measurements of some lines will yield new information about the branching ratios or relative transition probabilities for the excited states.

This is the first year of a 2-year continuing grant, currently supported under NSF grant PHY78-02384A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0034, NEUTRON CROSS SECTION MEASUREMENTS IN THE keV ENERGY REGION

R.R. Winters, Denison University, School of Liberal Arts, Dept. of Physics, *Box 239, Granville, Ohio* 43023 (EY-76-S-02-2696)

Using the Oak Ridge Electron Linear Accelerator (ORELA), neutron total, scattering and capture cross sections in the eV and keV energy regions are measured. The nuclides selected for study are chosen in response to requests for cross section data for the various reactor energy production programs, because of their importance to astrophysical nucleosynthetic processes and to understand nuclear structure. During this collaborative research effort, cross sections for approximately 30 nuclides have been measured. Most recently, a measurement of the neutron capture cross sections for sulfur and scattering cross section for 238-U has been made in response to the official NDC/16U request list.

BIBLIOGRAPHIC REFERENCES: Macklin, R.L., and R.R. Winters, Resonance Capture Reactions with a Total Energy Detector, in Neutron Capture Gamma-Ray Spectroscopy, R.E. Chrien and W.R. Kane (eds.), Plenum Publishing Corp., N.Y., 1979. Macklin, R.L., J. Halperin and R.R. Winters, Absolute Neutron Capture Yield Calibration, Nucl. Instr. Meth. 164: 213-214 (1979).

SUPPORTED BY U.S. Dept. of Energy, Div. of Nuclear Physics

8.0035, RESEARCH INTO TRANSPORT, THERMAL AND MAGNETIC PROPERTIES OF SOLIDS

J.A. Rayne, Carnegie Mellon University, Carnegie Inst. of Technology, Dept. of Physics, *Frew Ave. & Margaret Morrison, Pittsburgh, Pennsylvania* 15213 (DMR79-23355)

Research into the transport, thermal and magnetic properties of solids will be continued. Particular emphasis will be placed on experiments in linear chain antiferromagnetic insulators of the type ABX3. Among the techniques to be used are acoustic attenuation and velocity measurements, as well as thermal expansion and magnetostriction studies. These experiments will provide considerable insight into the interaction between the magnetic structure and phonons in these compounds. Further research into the shear-wave attenuation in transition metals will be carried out. Acoustic studies in polycrystalline samples of V3Si and V3Ge will be employed to investigate the correlation between superconductivity, lattice instability and electron concentration in these systems.

This is the first year of a three year continuing grant. This research was previously supported under DMR76-80939.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0036, MOSTLY ONE DIMENSIONAL MAGNETISM

J.C. Bonner, University of Rhode Island, School of Arts & Sciences, Dept. of Physics, *Kingston, Rhode Island* 02881 (DMR80-10819)

Research previously supported by DMR7724136.

Theoretical research will be carried out on quasi-1-D systems, both for their intrinsic interest and in order to apply the results to a variety of experimental situations. Considerable progress has so far been made on quantum magnetic chain calculations, approximate and exact, for a variety of systems. Interest, both theoretical and experimental, has continued to grow in spin-Peierls systems, unique quasi-1-D magneto-elastic compounds which display novel multicritical behavior in non-zero magnetic field (and pressure). In future work, use will be made of zero and finite temperature mappings between d-dimensional quantum systems and (d plus 1)-dimensional classical systems. The focus will therefore not be entirely one-dimensional. Two distinct real space renormalization group (RG) calculational schemes will be exploited in this connection: the Monte Carlo

RG method and the T equals O quantum RG method. Finally, a project on quantum effects in spin dynamics will be pursued with experimental application to a variety of quasi-1-D experimental compounds, ferro- and antiferromagnetic, with various types of anisotropy, in zero magnetic field.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0037, MATERIAL SUPPORT TECHNOLOGY - THIN FILMS, SURFACES, AND INTERFACES - A FOURIER-TRANSFORM THEORY OF THEIR ELECTRONIC STRUCTURE

H.J. Monkhorst, Utah Higher Education System, University of Utah, School of Science, Dept. of Physics, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (DN775345; N00014-77-C-0319)

The Navy has need for improved performance solid state electronic devices. One limitation has been a less than adequate understanding of the surface and interface physics of these devices. This program will assess new techniques for obtaining an understanding of these semiconductor surfaces and interfaces.

A new theoretrial approach is being developed for electronic structure calculations on thin films, surfaces and interfaces. The fourier-transform technique developed for bulk solid calculations is being adapted into a two dimensional version for application to surfaces. In the first stage, energies and electronic states are calculated at the Hartree-Fock level. At a later stage, electron correlation effects will be included. The properties for simple prototype solids will be calculated first and eventually applied to semiconductors. Various surface reconstruction effects in these materials will be considered.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0038, THE COLLISIONAL DYNAMICS FOR COLLISIONS OF UF6 WITH ATOMS AND MOLECULES

R.L. Champion, College of William & Mary, Williamsburg College, School of Arts & Sciences, Dept. of Physics, *Ewell Hall, Williamsburg, Virginia* 23185 (DF056440; F49620-79-C-0219)

AF function - this proposed research primarily falls in the 6.3 research objectives which deal with weapon effects. The generation of electron, proton and heavier material beams and their effects on different targets will be studied. It is also intended that ways to limit or reduce the damage will be investigated. Deficiency - at present, data and methods to reduce the damage caused by particle beams is almost non-existent. Objective - an experimental program will be carried out to generate heavy particle beams and to study the damage caused by electrons, protons and heavier particle beams. Contribution -this research is a part of a comprehensive program in radiation and particle interaction with matter investigations.

A study of the collisional dynamics of UF(6) with atoms and molecules in the four areas below constitute the approach. (1) Study the reaction of UF(6-) with a variety of targets including atomic, diatomic and plyatomic species. The absolute total cross sections for the various reaction channels such as those given by (3) will be measured. These measurements should be accurate to within 10 percent. (2) The energy range of the experiments will be extended to include the region from below threshold for the different processes up to 1 keV. (3) A particularly interesting and potentially important aspect of the proposed research involves varying the initial internal energy distribution of the primary ion beam, UF(6-). This can be simply accomplished by varying the temperature of the surface attachment source, since UF(6-) has many low lying vibrational modes (and possibly electronic states) and is surely in thermodynamic equilibrium with the hot surface upon desorption. From statistical consideration, one would anticipate the branching ratios for the outgoing channels to be a sensitive function of the initial excitation energy of the parent ion. (4) An attempt will be made to analyze the experimental results in the framework of statistical models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0039, SURVEILLANCE - SUPERCONDUCTIVE ELECTRONICS

B. Deaver, University of Virginia, School of Arts & Sciences, Dept. of Physics, *Garrett Hall, Charlottesville, Virginia* 22903 (DN775534; N00014-77-C-0440)

The objective is to study the properties of superconducting microbridge devices using the Josephson effects for millimeter wave mixing and for new types of infrared detectors and optically controlled fast digital devices of interest to the Navy for surveillance.

A millimeter wave mixer opeating above 100 GHz is being built using superconducting niobium variable thickness microbridges. Its properties are being characterized by measurements of the DC I-V curves for various values of temperature, magnetic field and incident microwave power. Device interactions with semiconductor substrates are being studied as a function of type of semiconductor, type of impurity dopant, temperature, magnetic field and intensity and wavelength of light irradiating the junction region.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0040, EROSION OF CONDENSED GASES BY FAST IONS - PHYSICAL MECHANISM AND ASTROPHYSICAL IMPLICATIONS

R.E. Johnson, University of Virginia, School of Engineering & Applied Science, Dept. of Nuclear Engineering & Engineering Physics, *Garrett Hall, Charlottesville, Virginia* 22903 (AST79-12690)

In a cooperative project involving the Bell Telephone Laboratories and the University of Virginia, an experimental and theorectical study of the erosion rates of ices by high energy ion beams will be undertaken. With the experimental part being performed at Bell Labs and the theoretical treatment at the University, an effort will be made to develop a model which explains observed phenomena and can be used to predict behavior in experimentally unobservable situations. These new results will then be applied to the astrophysically interesting areas of erosion from the surfaces of the satellites of the outer planets and of ice grains in the rings of Saturn.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

8.0041, VIBRATIONAL SPECTROSCOPY AT HIGH PRESSURE

W.F. Sherman, University of London, Kings College, Dept. of Physics, *Strand, London, England, United Kingdom* (DA0C9456; DAERO 76 G0054)

Study on the lattice dynamics of crystals in a variety of systems as a function of pressure and temperature. Behavior near phase transitions is particularly important. New high pressure cells for use in Raman and infrared spectroscopy are to be designed and constructed. Such cells will not contain diamond anvils/windows and will attempt to extend the limit of pressure obtainable by less expensive materials. Such studies, techniques, and equipment have immediate application to a variety of current U.S. Army research interests in many areas including the fields of energetic materials and electronic materials. Additionally, a new and novel narrow bandwidth filter, tunable over frequencies from the IR to UV, is to be used in this effort. The concept of this filter is in the process of review for assistance in patenting by the U.S. Navy. It appears to represent orders of magnitude improvement in detection of low intensity lines, such as a Raman line, at frequencies very near a high intensity line, such as a laser line. Further development and improvement of this device holds significant potential for U.S. Army's programs in camouflage detection, chemical and pollution detection, and in most research efforts involving laser spectroscopy.

Infrared and Raman studies are to be carried out over wide ranges of pressure and temperature on a variety of crystalline materials. High pressure optical cells will be developed to extend where necessary the range of these experiments. The purpose of this work is to improve our understanding of inter-

molecular forces, molecular motion in solids, and the detailed mechanism of solid-solid phase changes.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Research & Standardization Group

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, MEASUREMENTS OF ATMOSPHERIC CONSTITUENTS AT THE SOUTH POLE

D.G. Murcray, University of Denver, School of Arts & Sciences, Dept. of Physics & Astronomy, *2115 S. University Blvd., Denver, Colorado* 80210 (DPP79-20187)

An infrared spectrometer will be operated at South Pole Station during the austral summers of 1980/81 and 1981/82 to obtain high resolution solar spectral data. From these data, information will be obtained on the concentration of a number of important trace gas constituents such as ozone, fluorocarbons, nitric acid, and oxides of nitrogen over Antarctica.

This work is a continuation of work previously supported under NSF Grant Number DPP 77-24304.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Polar Programs

10.0002, STELLAR PARALLAXES AND PROPER MOTION

W.F. Van Altena, Yale University, Graduate School, Dept. of Astronomy, *206 Elm, New Haven, Connecticut* 06520 (AST76-81339 A03)

A program of astrometric research, with increasing emphasis on southern hemisphere coverage, will be continued. The determination of stellar parallaxes and proper motions by astrometric methods furnishes basic data important to other areas of astronomy. A star's distance from parallax measures permits finding the true brightness of the star and its position in space. The motions, from a comparison of stellar positions made with an interval of several years between observations, help to determine the sun's path among the stars and its position within our Galaxy. The yardstick for all cosmic distances ultimately depends on these astrometric researches.

Over the next three years the Yale investigators will work to reduce the deficiency of astrometric observations in the southern skies. Completion of the Yale Southern Proper Motion Program first epoch observations in Argentina, and an extension of the overlap with the Lick Observatory Northern Program, will be given top priority. Stellar parallax determinations in southern star clusters from proper motion studies will be undertaken with the Yale astrometric telescope at Cerro Tololo Inter-American Observatory in Chile. A continuing effort will be made towards improving astrometric instrumentation and deriving all relevant positional information from photographic images to better utilize existing and future plate material.

Prior support was by NSF grant 76-81339A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0003, OBSERVATIONAL STUDIES OF VARIABLE CHROMOSPHERIC ACTIVITY IN SOLAR-LIKE STARS

A.H. Vaughan, Carnegie Institution of Washington, *1530 P St. N.W., Washington, District of Columbia* 20005 (AST79-21070)

This research will be devoted to an observational study of solar-like stellar cycles and related variable chromospheric activity in solar-like stars. A three-month period of time on the Mount Wilson 60-inch telescope will be devoted to carrying out an intensive pilot study of rapid variations that are observed to be superimposed on long-term cyclic variations in chromospheric H and K emission in solar-like main sequence stars. The stars to be observed will include those whose stellar cycle timescales are known. The data to be acquired on both the rotational and cyclical timescales of stars other than the sun will constitute a unique contribution of importance to the development of theories of the solar cycle and its analog in other stars.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0004, OBSERVATIONS OF MASS LOSS FROM HD-193793 AND OTHER WOLF-RAYET STARS

S.T. Gottesman, State University System of Florida, University of Florida, College of Liberal Arts & Sciences, Dept. of Astronomy, *208 Tigert Hall, Gainesville, Florida* 32601 (AST78-01278)

Wolf-Rayet stars are hot, luminous stars with expanding atmospheres. Material is being ejected from them as a stellar wind at a rate of at least a billion times that of the sun. The structure, the physical cause for the high mass loss rates, and the evolutionary history of these stars are not understood. This project will be concerned with radio observations of Wolf-Rayet stars, and in particular one known as HD-193739. A large change has occurred in the stellar wind of HD-193793. By observing radio waves from the tenuous, outer regions of its stellar wind this disturbance can be studied. Variations in the rate of mass ejection, and the expansion velocity of the stellar wind will be determined.

In addition to HD-193793, only two other radio emitting Wolf-Rayet stars are known. The Very Large Array in New Mexico and the Green Bank radio interferometer in West Virginia will be used to search for radio emission from other Wolf-Rayet stars.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0005, FAINT PHOTOELECTRIC PHOTOMETRIC STANDARD STAR SEQUENCES

A.U. Landolt, Louisiana State University, Agricultural & Mechanical College, School of Science, Dept. of Physics & Astronomy, *University Station, Baton Rouge, Louisiana* 70803 (DF047270; AFOSR-77-3218)

AF function - reconnaissance and surveillance of spacecraft. Deficiency - lack of photometric calibration of faint stars to verify detection performance of optical surveillance systems. Objective - to establish photometric standards for stars in magnitude interval 12 and 17 over as wide a range of color index as possible. Contribution - faint standard stars will permit the calibration of detectors now in use or under development.

The observations at Cerro Tololo Inter-American Observatory in Serena, Chile of 7th to 9th magnitude stars will be completed at the 0.4 meter telescope. The observations of 10th to 12th magnitude stars will proceed on the 0.9 meter telescope using the 0.4 meter observations as standard stars. Bootstrapping of the 0.9 meter observations to the 1.5 meter telescope will be undertaken for the 13th to 15th magnitude range. Time on the 4 meter telescope will be requested to begin to create standard stars of the 16th to 17.5th magnitude. Photographic observations at the 1.0 meter telescope virtually will be completed. Construction of the two-star photometer will be completed and testing will begin.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

10.0006, STUDIES IN THE STRUCTURE OF INTERSTELLAR CLOUDS AND EVOLVING BINARY STARS

B.P. Flannery, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Astronomy, *Cambridge Station, Cambridge, Massachusetts* 02138 (AST80-02404)

Research in several areas of theoretical astrophysics will be carried out. The first part of the research program is to construct a theoretical model of diffuse and molecular clouds. New methods have been developed to describe the penetration of ultraviolet radiation into clouds. This allows a more accurate description of radiative transfer effects which profoundly influence

cloud structure. The models should provide a better framework for analysis of spacecraft ultraviolet and ground-based observations of molecular clouds. The second part is research concerning the fate of binary stars that evolve into contact so that one star 'swallows' its companion. Several classes of close evolved binary systems, e.g., cataclysmic variables, x-ray binaries, and the binary pulsar, probably are born in the contact phase. The explanation of the evolution of binary stars remains the outstanding theoretical problem in astronomy. The final parts are several ambitious, or less developed projects including stability of Bondi accretion, hydrodynamic solution of Bondi-Hoyle accretion for a range of adiabatic indices, analysis of the uncertainty in age determinations of globular clusters, and a study of the influence of fluctuations on screening corrections for nuclear reaction rates in stellar cores. The latter topic may prove to be of relevance in the long standing solar neutrino problem.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0007, COSMOLOGY, RELATIVITY, AND THEORETICAL ASTROPHYSICS

W.H. Press, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Physics/Astronomy, *Cambridge Station, Cambridge, Massachusetts* 02138 (PHY80-07351)

Research in theoretical astrophysics and gravitational physics initiated under NSF grant PHY78-09616A01 will be continued. Among topics to be investigated are: 1. Cosmology: (a) Theory of the quadrupole-dipole ratio for the microwave background; (b) study of perturbations. 2. Relativity: (a) Singular perturbation expansions; (b) motion of extended charged and spinning objects. 3. Relativistic Astrophysics: (a) Accretion disk studies; (b) magnetodynamics; (c) internal waves in solar and stellar interiors.

This is the first year of a three-year continuing grant, previously supported by NSF under grant PHY78-09616A01.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical
Sciences, Div. of Physics

10.0008, COSMIC RAY ACCELERATION IN THE SUN-EARTH ENVIRONMENT

D.J. Mullan, Franklin Inst. of the State of Pennsylvania, *20th & Benjamin Franklin Pkwy., Philadelphia, Pennsylvania* 19103 (ATM78-20936 A01)

The emission of energetic cosmic ray particles and shock waves from the sun during certain solar flares disturbs the space environment around the Earth. In order to understand and predict these disturbances, the aim of this research has been to investigate various physical processes which relate shock waves in the solar atmosphere and cosmic ray acceleration to high energies. Previous work has shown how shocks are influenced by certain large magnetic field structures (neutral sheets) in the solar corona. When the neutral sheets are small in size, the shock sets them into violent turbulent motion when it sweeps past. This turbulent motion can accelerate solar flare particles to energies of 100 million electron volts and higher. Since neutral sheets exist on a wide variety of scale sizes in the sun-Earth environment, the grant will extend the investigation of shock propagation near neutral sheets to a broad range of conditions. This will permit an investigation into turbulent conditions on various scales accelerate cosmic rays both in the solar corona and in interplanetary space. Particle acceleration in neutral sheets will also be applied to the problem of recently reported peculiarities in the chemical composition of cosmic rays from certain solar flares.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0009, SIMULTANEOUS PHOTOMETRIC & RADIAL VELOCITY OBSERVATIONS OF CLASSICAL CEPHEIDS - A COLLABORATIVE INVESTIGATION BY PURDUE & U. OF TEXAS

T.G. Barnes, University of Texas, Austin Campus, School of Natural Sciences, Dept. of Astronomy, *200 W. 21st St., Austin, Texas* 78712 (AST79-19826)

This project, to be carried out jointly at the University of Texas at Austin and Purdue University will acquire simultaneous photometry and radial velocities for 64 classical Cepheid stars. The photometric observations will lead to light and color variations which, when transformed to a standard system, will be precise to an accuracy of about 0.02 magnitudes. Simultaneous radial velocity observations will be made with a photoelectric radial velocity spectrometer.

Research topics which will benefit from this data include (1) the determination of the radii of Cepheid variables, (2) the improvement of the period-luminosity-color relation, (3) the discovery of new binary Cepheid stars, (4) the photometric determination of Cepheid effective temperatures, and (5) an improved definition of light and color curves for comparison with new hydrodynamical models.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

GENERAL

11.0001, WESTERN INFLUENCES ON THE ASTRONOMY OF THE HOPI INDIANS - THE INTERPLAY OF TRADITIONAL AND MODERN SCIENCE

S.G. McCluskey, West Virginia University, School of Arts & Sciences, Dept. of History, *Morgantown, West Virginia* 26506 (SOC78-05768)

A series of recent studies has demonstrated the astronomical capabilities of the traditional science of 'primitive' peoples. Most of these studies, however, have failed to integrate traditional astronomy with the religious myths and rituals in which it is embodied.

Dr. McCluskey has recently published a study of the astronomical practices at one Hopi pueblo that begins to define a working system of traditional astronomy within its cultural context. He is now extending his analysis by using data from other villages where published data suggest significant differences, some due to European influences, are to be found. This study should resolve three questions by clarifying the astronomical and cosmological concepts underlying Hopi astronomy, separating the variable elements from the essential core of this tradition, and defining the historical changes of this tradition under internal tensions and the external pressures of a scientifically advanced culture. This last aspect transcends the Hopi and their astronomical tradition, and may lead to generalizations concerning how cultural contacts modify scientific ideas. For example, understanding the influence of European astronomy and culture upon the Hopi may contribute to an understanding of the influence of Roman science and culture upon the traditional astronomy of Northern Europe.

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N81-15968* National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 129, DECEMBER 1980
Dec. 1980 114 p
(NASA-SP-7037(129); NTISUB/141/093) Avail: NTIS HC $5.00 CSCL 01A

This bibliography lists 384 reports, articles, and other documents introduced into the NASA Scientific and Technical Information System in November 1980. Author

N81-15969*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED FRONTIER. CASE HISTORIES OF FOUR NACA PROGRAMS, 1920 - 1950
John V. Becker 1980 196 p refs
(NASA-SP-445(01); LC-80-607935) Avail: NTIS MF A01; SOD HC $6.50 CSCL 01B

The case histories focus on the fields of supersonic flow and aircraft design. The development of supersonic airfoils is described along with the development of test facilities such as transonic wind tunnels and slotted wind tunnels. Emphasis is placed on propeller blade design and configurations. The history of supersonic flow theory is presented. For individual titles, see N81-15970 through N81-15973.

N81-15970*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED AIRFOIL PROGRAM **c02**
In its The High-Speed Frontier 1980 p 3-60 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

A case history is presented of the work done in the field of supersonic flow and aerodynamics. Emphasis is placed on the development of supercritical wings and the study of the effects of supersonic speeds on propeller blades for aircraft. A review is presented of important milestones in the development of supercritical and transonic aerodynamic theory. T.M.

N81-15971*# National Aeronautics and Space Administration, Washington, D. C.
TRANSONIC WIND TUNNEL DEVELOPMENT (1940 - 1950) **c09**
In its The High-Speed Frontier 1980 p 61-118 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 14B

A case history is presented for the wind tunnel program of the National Advisory Committee for Aeronautics. The choking problem is discussed and the development of the repowered 8-foot high speed tunnel is described. Transonic airfoil facilities of interest include the annular transonic tunnel and the slotted transonic tunnel. High speed research airplanes used for wind tunnel testing and wing-flow and bump methods are also discussed. T.M.

N81-15972*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED PROPELLER PROGRAM **c07**
In its The High-Speed Frontier 1980 p 119-138 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

A case history is presented for the propeller program of the National Advisory Committee for Aeronautics. The work was concerned with the development of supersonic airfoils for aircraft applications. Propeller blade pressure distributions at high speeds were investigated. High speed flight tests of various propeller configurations were conducted and a high speed dynamometer was developed. T.M.

N81-15973*# National Aeronautics and Space Administration, Washington, D. C.
HIGH-SPEED COWLINGS, AIR INLETS AND OUTLETS, AND INTERNAL-FLOW SYSTEMS **c05**
In its the High-Speed Frontier 1980 p 139-165 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01C

A case history is presented of the National Advisory Committee on Aeronautics' program of aircraft engine development. The ramjet engine is described and its development is traced through work done in the field of supersonic inlets. The effects of heat and compressibility on internal flow systems in engines are discussed. T.M.

N81-15974*# Kansas Univ., Lawrence.
A FEASIBILITY STUDY FOR ADVANCED TECHNOLOGY INTEGRATION FOR GENERAL AVIATION Final Report, 10 Apr. 1979 - 9 Apr. 1980
David L. Kohlman, Garey T. Matsuyama, Kevin E. Hawley, and Paul T. Meredith Nov. 1980 533 p refs
(Contract NAS1-15770)
(NASA-CR-159381; KU-FRL-414-1) Avail: NTIS HC A24/MF A01 CSCL 01B

An investigation was conducted to identify candidate technologies and specific developments which offer greatest promise for improving safety, fuel efficiency, performance, and utility of general aviation airplanes. Interviews were conducted with general aviation airframe and systems manufacturers and NASA research centers. The following technologies were evaluated for use in airplane design tradeoff studies conducted during the study: avionics, aerodynamics, configurations, structures, flight controls, and propulsion. Based on industry interviews and design tradeoff studies, several recommendations were made for further high payoff research. The most attractive technologies for use by the general aviation industry appear to be advanced engines, composite materials, natural laminar flow airfoils, and advanced integrated avionics systems. The integration of these technologies in airplane design can yield significant increases in speeds, ranges, and payloads over present aircraft with 40 percent to 50 percent reductions in fuel used. T.M.

N81-15975# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A FEASIBILITY STUDY FOR ADVANCED TECHNOLOGY INTEGRATION FOR GENERAL AVIATION Ph.D. Thesis - Kansas Univ. Final Report

Garey T. Matsuyama May 1980 529 p refs

(AD-A092437; AFIT-CI-80-22D) Avail: NTIS HC A23/MF A01 CSCL 01/3

A study directed toward the identification and evaluation of applicable advanced technologies for general aviation was performed. An extensive data base was generated through visits to 31 general aviation manufacturers and 3 NASA research centers as well as through an exhaustive literature search. An evaluation technique was developed which allowed candidate technologies to be ranked according to potential benefit. Finally, design studies were performed for a 6-passenger personal/business airplane and a 19-passenger commuter airplane. The General Aviation Synthesis Program (GASP) was utilized during the design studies for propulsion system and vehicle sizing as well as mission performance analysis. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N81-15976*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECTS OF SIDEWALL GEOMETRY ON THE INSTALLED PERFORMANCE OF NONAXISYMMETRIC CONVERGENT-DIVERGENT EXHAUST NOZZLES

Jeffery A. Yetter (George Washington Univ., Hampton, Va.) and Laurence D. Leavitt Dec. 1980 119 p refs

(NASA-TP-1771; L-13826) Avail: NTIS HC A06/MF A01 CSCL 01A

The investigation was conducted at static conditions and over a Mach number range from 0.6 to 1.2. Angle of attack was held constant at 0 deg. High pressure air was used to simulate jet exhaust flow at ratios of jet total pressure to free-stream static pressure from 1 (jet off) to approximately 10. Sidewall cutback appears to be a viable way of reducing nozzle weight and cooling requirements without compromising installed performance. T.M.

N81-15977*# Boeing Co., Seattle, Wash.

A SYSTEM FOR AERODYNAMIC DESIGN AND ANALYSIS OF SUPERSONIC AIRCRAFT. PART 4: TEST CASES Final Report, Sep. 1978 - Aug. 1980

W. D. Middleton and J. L. Lundry Washington NASA Dec. 1980 225 p refs 4 Vol.

(Contract NAS1-15534)

(NASA-CR-3354; D6-41840-4) Avail: NTIS HC A10/MF A01 CSCL 01A

An integrated system of computer programs was developed for the design and analysis of supersonic configurations. The system uses linearized theory methods for the calculation of surface pressures and supersonic area rule concepts in combination with linearized theory for calculation of aerodynamic force coefficients. Interactive graphics are optional at the user's request. Representative test cases and associated program output are presented. T.M.

N81-15978*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECT OF WING LOCATION AND STRAKES ON STABILITY AND CONTROL CHARACTERISTICS OF A MONOPLANAR CIRCULAR MISSILE WITH LOW-PROFILE TAIL FINS AT SUPERSONIC SPEEDS

A. B. Blair, Jr. Dec. 1980 200 p refs

(NASA-TM-81878; L-13852) Avail: NTIS HC A10/MF A01 CSCL 01A

A wind tunnel test was conducted at Mach numbers from 1.70 to 2.86 to extend the aerodynamic data base for wing tail effect on stability and control characteristics of monoplanar missiles. The results are summarized to show the effects of tail fin dihedral angle, wing location, and nose body strakes. The results indicate that an increase in tail fin dihedral angle produces positive increments in directional stability that allow greater trimmed lift coefficient values (maneuver potential) to be obtained. An increase in wing tail gap for the Mach number range reduces the aerodynamic center travel and produces reductions in directional stability at the lower angles of attack. A change in wing height (vertical location) strongly influences the angle of attack at which pitch up and the most directional stability occur. The addition of strakes to the baseline configuration increases directional stability, which allows a significant increase in stable trimmed maneuver capability. The tail fins of the baseline configuration are effective in producing roll and yaw control that are accompanied by favorable yaw and roll, respectively. R.C.T.

N81-15979# Royal Aircraft Establishment, Farnborough (England).

A REVERSE PSEUDO-UNSTEADY AERODYNAMIC CALCULATION METHOD

G. Meauze Jul. 1980 22 p refs Transl. into ENGLISH from Rech. Aerosp. (France), no. 1, 1980 p 23-30

(RAE-LIB-Trans-2048) Avail: NTIS HC A02/MF A01

A method is described that provided the geometry of a wall corresponding to a given velocity distribution. The velocity distribution can be assigned to the whole duct wall whose geometry is looked for, or only to an element of it, where the remaining geometry is assumed known. This flexibility of use confers on the method a wide field of application. The method makes it possible to treat the case of flow with shock waves for a two dimensional flow with possible variation of cross section. This type of calculation finds an immediate application for defining the walls of a duct, such as an air intake or a nozzle, as well as the profiles of turbomachine blades. This method can also contribute to the understanding and exploitation of experimental results, making it possible to determine the flow field corresponding to the measured wall pressure distributions. T.M.

N81-15980*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.

EXPERIMENTAL INVESTIGATION OF VORTICES SHED BY VARIOUS WING FIN CONFIGURATIONS M.S. Thesis. Final Report

J. Iversen and M. Moghadam Jan. 1981 157 p refs

(Grant NsG-1582)

(NASA-CR-163874; ISU-ERI-Ames-81112) Avail: NTIS HC A08/MF A01 CSCL 01A

Forty-six different fins, which were members of twelve plan-form families, were tested. A two dimensional Boeing single element airfoil at an angle of attack of eight degrees and a sweepback angle of thirty-two was used to simulate a portion of the wing of a generator aircraft. Various free stream velocities were used to test any individual fin at its particular angle of attack. While the fin itself was mounted on the upper surface of the generator model, the angle of attack of each fin was varied until stall was reached and/or passed. The relative fin vortex strengths were measured in two ways. First, the maximum angular velocity of a four blade rotor placed in the fin vortex center was measured with the use of a stroboscope. Second, the maximum rolling moment on a following wing model placed in the fin vortex center was measured by a force balance. T.M.

N81-15981*# Neilsen Engineering and Research, Inc., Mountain View, Calif.

THEORETICAL STUDY OF HULL-ROTOR AERODYNAMIC INTERFERENCE ON SEMIBUOYANT VEHICLES Technical Report, 14 Feb. - 7 Dec. 1977

S. B. Spangler and C. A. Smith Apr. 1978 97 p refs

(Contract NAS2-9512)

(NASA-CR-152127; NEAR-TR-159) Avail: NTIS HC A05/MF A01 CSCL 01A

Analytical methods are developed to predict the pressure distribution and overall loads on the hulls of airships which have close coupled, relatively large and/or high disk loading propulsors for attitude control, station keeping, and partial support of total weight as well as provision of thrust in cruise. The methods comprise a surface-singularity, potential-flow model for the hull

and lifting surfaces (such as tails) and a rotor model which calculates the velocity induced by the rotor and its wake at points adjacent to the wake. Use of these two models provides an inviscid pressure distribution on the hull with rotor interference. A boundary layer separation prediction method is used to locate separation on the hull, and a wake pressure is imposed on the separated region for purposes of calculating hull loads. Results of calculations are shown to illustrate various cases of rotor-hull interference and comparisons with small scale data are made to evaluate the method. M.G.

N81-15982*# National Aeronautics and Space Administration. *Langley Research Center, Hampton, Va.*

A FLIGHT INVESTIGATION OF PERFORMANCE AND LOADS FOR A HELICOPTER WITH RC-SC2 MAIN-ROTOR BLADE SECTIONS

Charles E. K. Morris, Jr., Robert L. Tomaine, and Dariene D. Stevens Dec. 1980 140 p Prepared in cooperation with Army Aviation Research and Development Command, Hampton, Va.

(NASA-TM-81898; AVRADCOM-TM-81-B-1) Avail: NTIS HC A07/MF A01 CSCL 01A

The test envelope included hover, forward-flight speed sweeps from 33 to 74 m/sec (65 to 144 knots), and collective-fixed maneuvers at about 0.25 tip-speed ratio. The data set for each test point describes vehicle flight states, control positions, rotor loads, power requirements and blade motions. Rotor loads were reviewed primarily in terms of peak-to-peak and harmonic content. Lower frequency components predominated for most loads and generally increased with increased airspeed, but not necessarily with increased maneuver load factor. T.M.

N81-15983*# National Aeronautics and Space Administration, Washington, D. C.

FLOW PHENOMENA ALONG FUSELAGES AND WING-FUSELAGE SYSTEMS OF GLIDERS

Jerzy Ostrowski, Mieczyslaw Litwinczyk, and Lukasz Turkowski Dec. 1980 16 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Poland), v. 25, no. 1, 1978 p 91-104 Original language document was announced as A78-36203 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(NASA-TM-75401) Copyright. Avail: NTIS HC A02/MF A01 CSCL 01A

The results are presented for visualization tests and measurements of the velocity field in diffusion regions (with a positive pressure gradient) for fuselages and transition regions between the wing and the fuselage. Wind tunnel and flight tests were performed. Specific emphasis was placed on examining the secondary flow influencing separation acceleration and the influence of the geometrical form of the wing fuselage system manifested by the occurrence of secondary flows of various types. R.C.T.

N81-15984*# National Aeronautics and Space Administration, Washington, D. C.

DISCUSSION OF TEST RESULTS IN THE DESIGN OF LAMINAR AIRFOILS FOR COMPETITION GLIDERS

Jerzy Ostrowski, Stanislaw Skrzynski, and Mieczyslaw Litwinczyk Dec. 1980 21 p refs Transl. into ENGLISH from Arch. Budowy Maszyn (Poland), v. 25, no. 1, 1978 p 105-120 Original language document was announced as A78-36204 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(NASA-TM-75402) Avail: NTIS HC A02/MF A01 CSCL 01A

The deformation of flow in the boundary layer and the local separation of a laminar layer (laminar bubbles) from various airfoils were investigated. These phenomena were classified and their influence is discussed. Various aerodynamic characteristics are discussed and the principles for prescribing pressure distribution to attain a high value of c sub z max with a possibly low drag coefficient are described. T.M.

N81-15985*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SOME WAKE-RELATED OPERATIONAL LIMITATIONS OF ROTORCRAFT

Harry H. Heyson Dec. 1980 53 p refs Presented at the Fourth Midwest Helicopter Safety Seminar, Joliet, Ill., 3-5 Feb. 1981; sponsored by the Illinois Dept. of Transportation and the FAA

(NASA-TM-81920) Avail: NTIS HC A04/MF A01 CSCL 01B

Wind tunnel measurements show that the wake of a rotor, except at near hovering speeds, is not like that of a propeller. The wake is more like that of a wing except that, because of the slow speeds, the wake velocities may be much greater. The helicopter can produce a wake hazard to following light aircraft that is disproportionately great compared to an equivalent fixed wing aircraft. This hazard should be recognized by both pilots and airport controllers when operating in congested areas. Ground effect is generally counted as a blessing since it allows overloaded takeoffs; however, it also introduces additional operation problems. These problems include premature blade stall in hover, settling in forward transition, shuddering in approach to touchdown and complicatons with yaw control. Some of these problems were treated analytically in an approximate manner and reasonable experiment agreement was obtained. An awareness of these effects can prepare the user for their appearance and their consequences. T.M.

N81-15986*# Mississippi Univ., University. Engineering and Industrial Research Station.

AN APPLICATION OF WAKE SURVEY RAKES TO THE EXPERIMENTAL DETERMINATION OF THRUST FOR A PROPELLER DRIVEN AIRCRAFT Final Report

K. R. Hall, S. J. Miley, and H. J. Tsai Feb. 1981 76 p refs (Grant NsG-1454)

(NASA-CR-163920; MSSU-EIRS-ASE-81-3) Avail: NTIS HC A05/MF A01 CSCL 01A

The lack of slipstream static pressure distribution seriously affected the results but recommendations for removing the deficiency are discussed. The wake survey rake is shown to be a valuable tool in aircraft flight testing. Flow characteristics in the wake of the propeller were examined. T.M.

N81-15987# Illinois Univ. at Urbana-Champaign, Urbana. Dept. of Mechanical and Industrial Engineering.

TRANNOZ: A COMPUTER PROGRAM FOR ANALYSIS OF TRANSONIC THROAT FLOW IN AXISYMMETRIC, PLANAR, AND ANNULAR SUPERSONIC NOZZLES Technical Report, Jun. 1978 - Jan. 1980

J. C. Dutton Apr. 1980 96 p refs

(Contract DAAG29-79-C-0184; Grant DAAG29-76-G-0200)

(AD-A091924; UILU-ENG-80-4005; ARO-13737.3-EX; ARO-16719.2-E23) Avail: NTIS HC A05/MF A01 CSCL 20/4

A FORTRAN computer program has been developed for the analysis of transonic throat flowfields in annular, planar, and axisymmetric supersonic nozzles. The program evaluates the series expansion solution developed by Dutton and Addy. The subroutines in the code are described together with the definitions of the input and output variables, detailed input instructions, and an example input file with the corresponding output. A brief summary of the theory upon which the expansion solution is based is also included. GRA

N81-15988# Bristol Univ. (England). Dept. of Aeronautical Engineering.

PRESSURES ON A SLENDER, AXISYMMETRIC BODY AT HIGH ANGLE OF ATTACK IN A VERY LOW TURBULENCE LEVEL AIR STREAM Annual Report, May 1979 - Jun. 1980

P. C. Dexter and J. W. Flower Oct. 1980 46 p refs

(Grant DA-ERO-77-G-073)

(AD-A092533; PCD/8001) Avail: NTIS HC A03/MF A01 CSCL 20/4

This report describes the work and results of the third year on this contract to investigate the pressures on slender bodies at high incidence. Results are presented of experimentally measured pressures on a model consisting of an axisymmetric cylindrical body with two interchangeable ogive nose sections in a low speed, low turbulence, low freestream. Incidences up to 90 deg and the full roll angles range were covered. The results show a dependence on roll angle but indicate that a 'universal regular' state may exist for the flow, with intermediate states also being possible. The 'regular' state involves the maximum

local force values. Local side force and normal force distributions are presented for a number of cases. A suitable test technique to attain scatter-free reproducible data is proposed. Details of flow visualisation using a wool tuft grid are given. GRA

N81-15989# Naval Ship Research and Development Center, Bethesda, Md.

***VORTEX SHEDDING FROM FINNED CIRCULAR CYLINDERS* Final Report**

John G. Telste and Hans J. Lugt Nov. 1980 51 p refs *(ZR0140201; SR0140301)*

(AD-A092725; DTNSRDC-80/124) Avail: NTIS HC A04/MF A01 CSCL 20/4

A computer program has been developed to simulate vortex shedding from circular cylinders with evenly distributed fins. These bodies may rotate continuously or oscillate in a parallel stream. The two-dimensional flow model consists of point vortices inserted in an otherwise potential-flow field. For the roll-up of the line of vortices the rediscretization scheme by Fink and Soh is used. Sample results are presented for vortex shedding from a flat plate at angles of attack of 45 deg and 90 deg, and from a circular cylinder with two fins at an angle of attack of 45 deg. GRA

N81-15990# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Aeromechanics Div.

SKIN FRICTION MEASUREMENTS AT A MACH NUMBER OF THREE AND MOMENTUM THICKNESS REYNOLDS NUMBERS UP TO A HALF MILLION Final Report, Jun. 1976 - Oct. 1979

Anthony W. Fiore Sep. 1980 70 p refs

(AF Proj. 2307)

(AD-A092826; AFFDL-TR-79-3136) Avail: NTIS HC A04/MF A01 CSCL 01/2

Surface shear stress measurements were made in the Flight Dynamics Laboratory's M3 M=3 Reynolds Number wind tunnel. The primary purpose of this research was to make shear stress measurements at very high Reynolds numbers for near adiabatic wall and zero pressure gradient conditions. The results are presented as the local skin friction coefficient versus both the momentum thickness and the length Reynolds number. The investigation was conducted on the nozzle wall at a nominal Mach number of three over the Reynolds number range of 20,000 + or - R sub e sub theta + or - or 500,000. The surface shear stress was measured with a balance. The resulting skin friction coefficients were verified by simultaneous measurements made with a Preston tube. The skin friction coefficient was also calculated using the Von Karman integral method. They were then compared with the experimental results of Matting et al., and Moore-Harkness along with the theories of Van Driest, Spalding-Chi, Wilson, and Shang et al. GRA

N81-15991# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

SUBSONIC/TRANSONIC CONFIGURATION AERODYNAMICS

Sep. 1980 447 p refs In ENGLISH partly in FRENCH Presented at the Fluid Dyn. Panel Symp., Munich, 5-7 May 1980

(AGARD-CP-285; ISBN-92-835-0276-0) Avail: NTIS HC A19/MF A01

A mixture of theoretical and experimental papers, many providing test theory comparisons, are presented. Subject matter ranges from simple wing fuselage interference for both fighter and airlift configurations to those involving additional components such as nacelle and pylons, powered jets, winglets, and most importantly stores and weapons. For individual titles, see N81-15992 through N81-16019.

N81-15992# Flow Research, Inc., Kent, Wash.

APPLICATION OF TRANSONIC POTENTIAL CALCULATIONS TO AIRCRAFT AND WIND TUNNEL CONFIGURATIONS

John E. Mercer and Earll M. Murman *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 15 p refs (For primary document see N81-15991 07-02)

(Contract N00014-78-C-0079; F4D600-79-C-0001)

Avail: NTIS HC A19/MF A01

The computation of inviscid transonic flow modeled by the full potential equation is presented for two geometrical configurations. The Jameson-Caughey finite volume method is used to solve the governing equations in conservative form. The development of suitable computational meshes together with computed results are presented for a swept wing in a wind tunnel and for a wing body configuration. *Author*

N81-15993# Societe Nationale Industrielle Aerospatiale, Toulouse (France).

A VARIATIONAL FINITE ELEMENT METHOD FOR SOLVING THREE DIMENSIONAL TRANSONIC FLOWS [UNE METHODE VARIATIONNELLE D'ELEMENTS FINIS POUR LA RESOLUTION D'ECOULEMENTS TRANSSONIQUES *TRIDEMENSIONNELS*]

Y. Vigneron, O. Brocard (ONERA), J. Bousquet, and T. Lejal *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 16 p refs In FRENCH (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

A finite element method was developed at Aerospatiale to simulate inviscid steady transonic flows around complex geometries such as wing fuselage configurations. In this method, aerodynamic flow is described by the general potential equation based on an extension of Bateman's variational principle for the transonic case. This formula reduces the number of iterations needed to obtain a solution. The unity of the solution is assured by the use of artificial viscosity under the form of 'delayed' density. The discretization of the problem is effected by trilinear isoparametric approximation on hexahedral elements. In the case of bearing flows, the Kutta-Joukowski condition is realized due to associated circulatory solutions. Practical results are presented to verify the method. They are compared to experimental results and to results from other numerical methods. Transl. by A.R.H.

N81-15994# Avions Marcel Dassault, Saint-Cloud (France). Dept. des Etudes Theoriques Aerodyn.

FINITE ELEMENT METHOD STUDY OF WING-FUSELAGE-NACELLE INTERACTIONS OF A FALCON 20 TYPE AIRCRAFT AT MACH = 0.79 [ETUDE PAR LA METHODE DES ELEMENTS FINIS DES INTERACTIONS VOILURE FUSELAGE-NACELLE D'UN AVION DU TYPE FALCON A MACH = 0,79]

Gilbert Heckmann *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs In FRENCH (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Adaptation of the Garrett ATF3-6 engine on the twin engine Falcon 20, equipped in series with a General Electric CF 700 engine, revealed an important and predicted growth of drag in transonic flow. Wind tunnel tests of the new configuration showed shocks on the front of the engine nacelle and on the back of the wing at the top face of the socket at Mach = 0.79. Air flow between the wing and the nacelle was locally supersonic. The shape and position of the nacelle and mast were modified. This complex fuselage wing mast nacelle configuration should be studied in supercritical flow while considering the flow from the engine. The finite element method permits calculation in three dimensional and transonic flow with shock waves in a geometric domain under conditions of the required limits. It is shown that the matrix from a transonic calculation method provides solutions to aerodynamic problems previously detectable only by flight and wind tunnel tests. Mathematical tools are described and results obtained on the original nacelle and on the definitive nacelle with modified shape and position are discussed. Transl. by A.R.H.

N81-15995# British Aerospace Aircraft Group, Brough (England). Kingston-Brough Div.

INCREASING THE VALUE OF AIRFORCES BY IMPROVING EXTERNAL STORE CONFIGURATION

Clifford L. Bore *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 6 p ref (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The value of improvements to the external stores configuration, such as reduced drag (with consequent improvements of performance), and reduced release disturbances to the trajectory are surveyed. It is shown that the effectiveness/cost ratio of a fighter G.A. airforce could be improved greatly by refining the

aerodynamics of external store carriage, and that the payoff in value should be over 100 times the cost of re-equipment. E.D.K.

N81-15996# *Aircraft Research Association Ltd., Bedford* (England).

PROSPECTS FOR EXPLOITING FAVOURABLE AND *MINIMIZING ADVERSE AERODYNAMIC INTERFERENCE* IN EXTERNAL STORE INSTALLATIONS

A. B. Haines *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 25 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

External store installations are frequently a source of considerable adverse aerodynamic interference giving large increases in drag, reductions in usable lift, and poor store release characteristics. Research has shown how this adverse interference can be greatly alleviated or even transformed into favorable interference. Some of the available evidence for a wide variety of arrangements are reviewed. The nature of the interference, both adverse and favorable, is described, particular emphasis being placed on the major adverse interference in standard multiple carriers and in some underwing installations. The possible benefits of wing tip carriage and carefully arranged underfuselage arrays are noted. The fact that dramatic improvements might be possible by adopting a radical approach to store carriage is stressed. E.D.K.

N81-15997# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

EVALUATION OF AIRCRAFT INTERFERENCE EFFECTS ON EXTERNAL STORES AT SUBSONIC AND TRANSONIC SPEEDS

Ronald Deslandes *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

In order to analyse the separation behavior of external stores from a combat aircraft, the store loads must be evaluated at all times after release. The resulting forces and moments are highly unsteady and depend upon the nonuniform flow field around the aircraft and the store motion itself. The exact evaluation of unsteady aerodynamics of such complicated configurations is nearly impossible, due to the required computer capacity and cost effectiveness. Simplificating assumptions leads to the quasilinearization of the time dependence to omit unsteady calculations and to the use of the flow angularity technique to minimize computational time. The MBB store separation program system is presented as a possible solution. The mixed experimental analytical approach is not restricted by compressibility effects, but is mainly described at subsonic flows. However, the transonic and supersonic extensions are mentioned, as well as the application of the program system to realistic combat aircraft missions under realistic conditions, such as jettison at high g maneuver, multiple jettison, and rail and drop launch of missiles. E.D.K.

N81-15998# Nielsen Engineering and Research, Inc., Mountain View, Calif.

STUDY OF TRANSONIC FLOW FIELDS ABOUT AIRCRAFT: APPLICATION TO EXTERNAL STORES

Stephen S. Stahara *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 18 p refs (For primary document see N81-15991 07-02)

(Contract F44620-75-C-0047)

Avail: NTIS HC A19/MF A01

A review is presented of an extensive experimental/theoretical program directed toward establishing a predictive method for determining (1) three dimensional transonic flow fields about parent aircraft and (2) loading distributions on external stores located in these nonuniform flow fields. The work represents several stages in the systematic development of a theoretical capability for enabling aircraft/store compatibility studies at transonic speeds with applications to aircraft/store design optimization and store certification programs. The objectives are two fold: (1) to describe the extensive companion experimental program and present highlights of those results, which include detailed measurements of both flow fields and surface pressures (parent and external store), taken in a systematic component buildup; and (3) to discuss the development of the associated theoretical method, describe its application to a class of idealized fighter bomber configurations, and display comparisons with data from the parallel experimental programs, including both flow field and store loading distribution results. E.D.K.

N81-15999# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Theoretical Aerodynamics Dept.

AERODYNAMIC SUBSONIC/TRANSONIC AIRCRAFT DESIGN STUDIES BY NUMERICAL METHODS

Wolfgang Schmidt *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 26 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The need and use of computational aerodynamics in the design of aircraft and missile configurations in steady flow conditions is explored through several examples. These include aircraft and missile synthesis programs for predesign and evaluation work of aircraft and missile weapon systems, subsonic and transonic airfoil and high lift design, subsonic and transonic inviscid and viscous wing and aircraft design including leading edge vortex flows, aircraft engine integration, and three dimensional flows with separation. Use of these numerical and semiempirical methods can substantially increase airplane performance capabilities while reducing risk, flow time, and testing requirements and thus total cost. The capabilities of current aerodynamic methods are demonstrated by comparison with windtunnel results and by case studies. Author

N81-16000# Institut fuer Theoretische Stroemungsmechanik, Goettingen (West Germany).

DESIGN OF ADVANCED TECHNOLOGY TRANSONIC AIRFOILS AND WINGS

H. Sobieczky *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 13 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

A systematic method to design supercritical shock free 2D and 3D configurations is described. Simplified examples were chosen from airfoils and wings which are used in advanced technology aerodynamic concepts. With the outlined methods theoretical tools are presented to extend essentially subsonic design aerodynamic into the transonic regime. T.M.

N81-16001# British Aerospace Aircraft Group, Hertfordshire (England). Fluid Dynamics Dept.

INTERFERENCE ASPECTS OF THE A310 HIGH SPEED WING CONFIGURATION

J. A. Jupp *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 16 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The effect of the fuselage representation on the inboard wing transonic design and the influence of the tailplane in the optimization of the wing twist for minimium drag are discussed. Highlights from the wind tunnel testing program are presented and include the development of the wing root leading edge fillet to improve wing/fuselage viscous interference, and the optimization of the flap support fairings for the minimum high speed interference. T.M.

N81-16002# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

TRANSONIC WING TECHNOLOGY FOR TRANSPORT AIRCRAFT

G. Krenz and B. Ewald *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 12 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The Aircraft Energy Efficiency Program is described. Results from the program are presented which describe the standard transonic wing aerodynamics, taking into account impacts on structure and aeroelastics. The main objectives of the program are the development of high aspect ration wings, better wing engine integration, and the development of active control with movable wing parts. T.M.

N81-16003# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

DESIGN AND EXPERIMENTAL VERIFICATION OF A TRANSONIC WING FOR A TRANSONIC AIRCRAFT

G. Redeker, N. Schmidt, and R. Mueller *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 14 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Force, moment, and wing surface pressure measurements were made on a half scale model of a wing fuselage configuration. Drag reduction was the major design concept and thus the basis for all modifications to the slender wing. Modifications include: increasing average wing thickness from 10.5% to 12.5%; reducing the leading edge sweep angle from 30 deg to 27 deg; and increasing the cruising lift coefficient to c sub L = 0.5. T.M.

N81-16004# National Research Council of Canada, Ottawa (Ontario).

THE TALE OF TWO WINGS

E. Atraghji, L. Thornquist (Saab-Scania), and L. Torngren (Aeronautical Res. Inst. of Sweden) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 10 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Two design philosophies for a wing for an attack aircraft were investigated experimentally. In the first case, the wing was equipped with a leading edge that could be deflected mechanically to cope with leading and maneuvering cases without suffering extensive drag. In the second case, the wing leading edge profile is permanently set as a compromise for all flight conditions. Results indicate that, using the second concept, a carefully tailored wing can be generated which need not suffer a drag penalty or a reduction in maneuver capability. Such a wing has the advantage of simplicity and lighter weight also. T.M.

N81-16005# British Aerospace Aircraft Group, Brough (England). Aerodynamics Dept.

SOME PARTICULAR CONFIGURATION EFFECTS ON A THIN SUPERCRITICAL VARIABLE CAMBER WING

D. R. Holt and B. Probert *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 18 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Variable camber devices were shown to represent a powerful means of matching a variety of disparate transonic points for a thin wing if designed into the wing from the outset. In particular, trailing edge devices allow for the provision of good high lift performance without degrading the sea level dash capability. Strakes were designed with only a small drag penalty by matching the strake to the wing streamlines at particular incidences. T.M.

N81-16006# National Aerospace Lab., Amsterdam (Netherlands). Theoretical Aerodynamics Dept.

A CONSTRAINED INVERSE METHOD FOR THE AERODYNAMIC DESIGN OF THICK WINGS WITH GIVEN PRESSURE DISTRIBUTION IN SUBSONIC FLOW

J. M. J. Fray and J. W. Slooff *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 9 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The method combines well established linear techniques for the analysis of thick wing configurations, and for the design of asymptotically thin wings. These techniques are used in an iterative way. The design codes were constructed in such a way that constraints on the spanwise distributions of thickness, twist, leading edge radius, and trailing edge angle can be taken into account. In this way the designer may execute control over the geometry at the cost of a penalty in the pressure distribution. Examples of application to a swept wing and a wing body configuration are presented. T.M.

N81-16007# British Aerospace Aircraft Group, Warton (England).

JET WING INTERACTION TO GIVE IMPROVED COMBAT PERFORMANCE

A. Vint *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 12 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Prediction techniques showed that a conventional propulsive jet at the wing trailing edge gives a significant improvement in the high lift characteristics of the wing providing deflections of up to 30 deg can be provided. Application of the predicted effects to a projected aircraft showed that the best configuration would be the canard, to provide beneficial trim effects of the deflected thrust, and that large improvements in sustained turn rate at low speed and in peak attained turn rate at low level would be obtained. Weight penalties associated with the required deflecting nozzles are presented. T.M.

N81-16008# Salford Univ. (England).

JET WING INTERFERENCE FOR AN OVERWING ENGINE CONFIGURATION

R. A. Sawyer and M. P. Metcalfe (British Aerospace, Manchester, England) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 10 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Detailed pressure distributions over the wing are presented for jet to free stream velocity ratios of 2:1, 3:1, and 5:1, over a range of incidence. The configuration of the jet nozzle, wing section, and the relative positions of the engine and the wing, correspond to a moderate by-pass ratio engine mounted over the wing of a low wing feeder liner aircraft. Entrainment rates into the jet and the path of the jet relative to the wing were established by flow measurement and flow visualization. Theoretical considerations showed that it is the bound vorticity associated with jet curvature which produces the pressure increments on the wing surface. T.M.

N81-16009# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

INTERFERENCE EFFECTS OF CONCENTRATED BLOWING AND VORTICES ON A TYPICAL FIGHTER CONFIGURATION

W. Staudacher *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 p 13 refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

Generation and/or stabilization and control of these vortex systems was obtained by planform variation (such as strakes, short coupled canards); modifications of wing section (shape and camber of leading edges and leading edge flaps); and concentrated spanwise blowing for arbitrary planforms. Specific and combined results of these modifications are presented. Optimum jet positions, in respect of various criteria applied, were derived. The effects of strakes and/or spanwise blowing on performance, stability and control, dynamic characteristics, and flow distributions are discussed. T.M.

N81-16010# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EXPERIMENTAL STUDY OF THE INTERACTION BETWEEN THE WING OF A SUBSONIC AIRCRAFT AND A NACELLE OF A HIGH BY-PASS RATIO ENGINE [ETUDE EXPERIMENTALE DE L'INTERACTION ENTRE UNE VOILURE L'AVION SUBSONIQUE RAPIDE ET UNE NACELLE DE MOTEUR A HAUT TAUX DE DILUTION]

P. Levant *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs In FRENCH; ENGLISH summary (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The oncoming of a new generation of subsonic transport aircraft (with supercritical wing and high by-pass ratio turbofans) has led to an experimental study of wing nacelle jet pylon interference in transonic flow. To this end, a test set-up was developed at the ONERA S3Ch wind tunnel. The nacelle models represent a turbofan by means of two compressed air jets. The scale is 1/18,5. The nacelles are fixed on a thrust balance measuring afterbody thrust and discharge coefficients. The wing is located between the sidewalls of the test section. Pressures are measured through 456 holes located on 8 airfoils. Drag coefficient of the wing is obtained by wake survey. The following parameters can vary: (1) wing/nacelle position; (2) upstream Mach number (from 0.3 to 0.8); (3) jet pressure ratio; (4) with/without pylon; and (5) type of nacelle. Wing nacelle

interference can be studied by means of total thrust drag analysis, as a function of the various parameters. The test set-up is described, and examples of results are presented illustrating the possibilities of this set-up. Author

N81-16011# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.

A WIND TUNNEL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF FORWARD SWEPT WINGS

T. M. Weeks, G. C. Uhuad, and R. Large *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 15 p (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

An experimental investigation of a forward swept wing and a state of the art equivalent aft swept wing was conducted to compare the relative performance of both wings at identical transonic maneuver design conditions and to determine any associated drag penalty of the forward swept wing for a high supersonic cruise condition. At the transonic maneuver design condition, the results indicate a significant reduction in the profile drag of the forward swept wing relative to the aft swept wing. The forward swept wing drag exhibited extreme sensitivity to wing root height and incidence variations. A relocation of the FSW root from a mid to high body position and an increase in incidence of 0.8 degrees resulted in a two hundred count drag reduction at C sub L = 0.9. A drag penalty was recorded at M = 2.0 for the forward swept 'cruise wing' which had the same sweep and 'box geometry' as the transonic maneuver wing but with reduced camber and twist accomplished by flap deflection. The drag penalty decreased at lower supersonic Mach numbers. The results indicate that aft swept wing transonic aerodynamic design methods can be used to design and analyze forward swept wings with only minor modifications. Author

N81-16012# Aeronautical Research Inst. of Sweden, Bromma. Aerodynamics Dept.

AN INVESTIGATION OF A SWEPT WING-BODY CONFIGURATION WITH DROOPED LEADING EDGE AT LOW AND TRANSONIC SPEEDS

Georg Drougge *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 10 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

A basic, non-drooped wing was designed (using an inverse transonic small disturbance method) to have a critical Mach Number of around M = 0.85 at C sub L = 0.2. The sweep angle is 25 deg, the aspect ratio 4 and the taper ratio 0.4. Several drooped leading edges, about 15 percent of the local chord and also including spanwise variation, were designed and tested. Numerical calculations were done for the low speed high lift case using a vortex lattice panel method and for the transonic speed case, first using a small disturbance method, later a full potential equation method (Jameson's FLO22) and finally also a full Euler equations method (Rizzi). The experimental investigations were performed at low speeds at FFA (Re approximately 3 x 10 to the 6th power) at transonic speeds at FFA (Re approximately 1.5 to 4 x 10 to the 6th power) and at NAE, Canada (Re approximately 12 to 18 x 10 to the 6th power). These are mainly balance measurements but also some pressure distribution measurements have been obtained. The results indicate that it is possible to design a wing which has no transonic cruise drag penalty but which has a higher maximum coefficient of left and also better maneuver performance than the wing without droop. Author

N81-16013# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AERODYNAMIC INTERACTION BETWEEN A CLOSE-COUPLED CANARD AND A SWEPTBACK WING IN TRANSONIC FLOW [INTERACTION AERODYNAMIQUE ENTRE UN CANARD PROCHE ET UNE AILE EN FLECHE EN ECOULEMENT TRANSSONIQUE]

Yves Brocard and Volker Schmitt *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 23 p refs In FRENCH (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

A swept wing model was tested with and without a canard in the transonic wind tunnel S2MA to study the effects of a closed coupled canard on the flow around the main wing. The most significant results in terms of force and pressure measurements on the main wing and wall flow visualizations are presented. The compressibility effect analysis for the wing alone configuration shows that the Mach number has a marked effect on the lift gradient at low incidence and on the vortex onset angle of attack. In transonic flow, the canard changes the flow field on the wing in a similar way as it does in incompressible flow: a decrease in the lift gradient and a delay in the vortex development. But the vortex lift decay is delayed so that the maximum lift is about the same with or without canard. The canard attenuates the discontinuity due to the vortex breakdown migration but increases two other discontinuities which occur at higher angles of attack and which are connected with the formation and the bursting of a quite strong secondary vortex. A.R.H.

N81-16014# Royal Aircraft Establishment, Farnborough (England).

SOME AERODYNAMIC INTERFERENCE EFFECTS THAT INFLUENCE THE TRANSONIC PERFORMANCE OF COMBAT AIRCRAFT

D. Treadgold and K. H. Wilson *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 17 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

The magnitude of the effects of viscous interactions, aeroelasticity and the aerodynamic interaction between the wing and fuselage are discussed in the context of a swept wing planform typical of some designs of combat aircraft. Illustrations drawn from experimental measurements and theoretical calculations show the significant influence of these factors on the form of the supercritical flow development at high subsonic speeds. Some experimental measurements are given which indicate how small changes to the contour of the fuselage can produce significant changes in the drag measured at high subsonic speeds. The example shows that fuselage shaping can contribute to the development of a desirable form of supercritical flow on the wing with consequential benefit in drag levels at these speeds. Author

N81-16015# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Aerodynamics Dept.

DESIGN STUDY FOR THE INNER WING OF A TRANSONIC WING-BODY COMBINATION OF ASPECT RATIO 8

N. Voogt and J. Th. v. d. Kolk *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 11 p refs (For primary document see N81-15991 07-02)

Avail: NTIS HC A19/MF A01

A transonic design procedure for wing body combinations combines direct and inverse panel type computations and is based on the relationship between the exact transonic solution and an equivalent subsonic pressure distribution. The latter can be obtained by applying the subsonic panel method at the design condition for a shock free airfoil designed by hodograph theory. Several problems arise in the design of the inner wing because of the three dimensional character of the flow, which prevents a unique determination of the equivalent subsonic pressure distribution. Two essentially different approaches were followed by prescribing either a subcritical or a supercritical flow condition at the wing root. It is shown that the subcritical flow condition at the wing root can be achieved for a range of wing geometries with leading edge extensions on the inner wing or alternatively, by applying extensive body contouring to a wing originally designed to have supercritical flow at the root. A.R.H.

N81-16016*# Grumman Aerospace Corp., Bethpage, N.Y.

COMPLEX CONFIGURATION ANALYSIS AT TRANSONIC SPEEDS

C. W. Boppe and P. V. Aidala *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 13 p refs (For primary document see N81-15991 07-02)

(Contracts NAS1-14732; F33615-78-C-3014)

Avail: NTIS HC A19/MF A01 CSCL 01A

Advanced performance requirements of new combat and transport aircraft together with design time constraints intensify the development and application of three dimensional computational analyses. A computational method which was developed for the specific purpose of providing an engineering analysis of

complex aircraft configurations at transonic speeds. Particular attention is given to the recently incorporated wing viscous interaction and canard capabilities. The treatment of fuselage fairings, nacelles, and pylons is reviewed. The means for keeping computing resources at reasonable levels are identified. Three configurations were selected for correlations with experimental data. Taken together, the comparisons illustrate the full extent of current analysis capabilities. The configurations include: (1) a wing fuselage canard fighter; (2) a transport with fuselage fairings, four nacelles, four pylons; and (3) a space vehicle which includes an external fuel tank and rocket boosters (transonic launch configuration). A.R.H.

N81-16017*# Boeing Military Airplane Development, Seattle, Wash. Advanced Airplane Branch.

THEORETICAL AND EXPERIMENTAL STUDIES OF AERODYNAMIC INTERFERENCE EFFECTS

I. H. Rettie *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 19 p refs Supported in part by NASA and USAF (For primary document see N81-15991 07-02)
Avail: NTIS HC A19/MF A01 CSCL 01A

Theoretical studies of aerodynamic forces on winglets shed considerable light on the mechanism by which these devices can reduce drag at constant total lift and on the necessity for proper alignment and cambering to achieve optimum favorable interference. Results of engineering studies, wind tunnel tests and performance predictions are reviewed for installations proposed for the AMST YC-14 and the KC-135 airplanes. The other major area of aerodynamic interference discussed is that of engine nacelle installations. Slipper and overwing nacelles have received much attention because of their potential for noise reduction, propulsive lift and improved ground clearance. A major challenge is the integration of such nacelles with the supercritical flow on the upper surface of a swept wing in cruise at high subsonic speeds. A.R.H.

N81-16018*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

DATA BASE FOR THE PREDICTION OF INLET EXTERNAL DRAG

O. J. McMillan, E. W. Perkins, and S. C. Perkins, Jr. *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 23 p refs (For primary document see N81-15991 07-02)
(Contracts NAS2-8874; NAS2-9513)
Avail: NTIS HC A19/MF A01 CSCL 01A

Results are presented from a study to define and evaluate the data base for predicting an airframe/propulsion system interference effect shown to be of considerable importance, inlet external drag. The study is focused on supersonic tactical aircraft with highly integrated jet propulsion systems, although some information is included for supersonic strategic aircraft and for transport aircraft designed for high subsonic or low supersonic cruise. The data base for inlet external drag is considered to consist of the theoretical and empirical prediction methods as well as the experimental data identified in an extensive literature search. The state of the art in the subsonic and transonic speed regimes is evaluated. The experimental data base is organized and presented in a series of tables in which the test article, the quantities measured and the ranges of test conditions covered are described for each set of data; in this way, the breadth of coverage and gaps in the existing experimental data are evident. Prediction methods are categorized by method of solution, type of inlet and speed range to which they apply, major features are given, and their accuracy is assessed by means of comparison to experimental data. Author

N81-16019# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

PHILOSOPHY AND RESULTS OF STEADY AND UNSTEADY TEST TECHNIQUES ON A LARGE SCALE TRANSPORT AIRCRAFT MODEL IN THE ONERA TRANSONIC TUNNEL S1 MA. PART 1: PHILOSOPHY AND RESULTS OF STEADY TESTS. PART 2: INTEREST OF LARGE MODELS IN UNSTEADY AERODYNAMICS

G. Anders, A. Giacchetto (ONERA, Modane, France), and A. Gravelle (ONERA, Paris) *In* AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 25 p refs Partly in ENGLISH and FRENCH (For primary document see N81-15991 07-02)
Avail: NTIS HC A19/MF A01

Steady and unsteady wind tunnel tests with a large scale half model performed in the large ONERA transonic wind tunnel S1 MA within the German technology program ZKP and the development phase of the A 310 Airbus are considered. Various test techniques are introduced, their advantages and problems are discussed. The test arrangement concept is described and typical results for each of the investigated items are presented. Test results are compared with those on a complete model at lower Reynolds numbers. Stationary measurements are described and discussed. Characteristic results from unsteady tests are also presented and correlations are shown. A.R.H.

N81-15970*# National Aeronautics and Space Administration, Washington, D. C.

THE HIGH-SPEED AIRFOIL PROGRAM

In its The High-Speed Frontier 1980 p 3-60 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N81-16020*# Douglas Aircraft Co., Inc., Long Beach, Calif.

CABIN FIRE SIMULATOR LAVATORY TESTS Final Report, Jun. 1978 - Jun. 1980

Kenneth J. Schutter and David M. Klinck May 1980 344 p refs
(Contract NAS9-15591)
(NASA-CR-160909; MDC-J4649) Avail: NTIS HC A15/MF A01 CSCL 01C

All tests were conducted in the Douglas Cabin Fire Simulator under in-flight ventilation conditions. All tests were allowed to continue for a period of one hour. Data obtained during these tests included: heat flux and temperatures of the lavatory; cabin temperature variations; gas analyses for O2, CO2, CO, HF, HCl, and HCN; respiration and electrocardiogram data on instrumented animal subjects (rats) exposed in the cabin; and color motion pictures. All tests resulted in a survivable cabin condition; however, occupants of the cabin would have been subjected to noxious fumes. T.M.

N81-16021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OZONE CONTAMINATION IN AIRCRAFT CABINS: RESULTS FROM GASP DATA AND ANALYSES

J. D. Holdeman and G. D. Nastrom (Control Data Corp., Minneapolis, Minn.) 1981 15 p refs Presented at the 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by the American Inst. of Aeronautics and Astronautics
(NASA-TM-81671; E-693) Avail: NTIS HC A02/MF A01 CSCL 01C

The global atmospheric sampling program pertaining to the problem of ozone contamination in commercial airplane cabins is described. Specifically, analyses of GASP data have: confirmed the occurrence of high ozone levels in aircraft cabins and documented the ratio of ozone inside and outside the cabins of two B747 airliners, including the effects of air conditioning modifications on that ratio; defined ambient ozone climatology at commercial airplane cruise altitudes, including tabulation of encounter frequency data which were not available before GASP; and outlined procedures for estimating the frequency of flights encountering high cabin ozone levels using climatological ambient ozone data, and verified these procedures against cabin measurements. Author

N81-16022*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HUMAN FACTORS OF FLIGHT-DECK AUTOMATION: NASA/INDUSTRY WORKSHOP

Deborah A. Boehm-Davis, Renwick E. Curry, Earl L. Wiener (Miami Univ., Coral Gables, Fla.), and R. Leon Harrison Jan. 1981 26 p refs Workshop held at Burlingame, Calif., 17-18 Jul. 1980
(NASA-TM-81260; A-8432) Avail: NTIS HC A03/MF A01 CSCL 01C

The scope of automation, the benefits of automation, and automation-induced problems were discussed at a workshop held to determine whether those functions previously performed manually on the flight deck of commercial aircraft should always be automated in view of various human factors. Issues which require research for resolution were identified. The research questions developed are presented. A.R.H.

N81-16023# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Industrial and Systems Engineering.

AIRCREW COMPLIANCE WITH STANDARD OPERATING PROCEDURES AS A COMPONENT OF AIRLINE SAFETY Ph.D. Thesis - Ohio State Univ.

Jeffrey Edward Schofield 1980 183 p refs
(AD-A092443; AFIT-CI-80-30D) Avail: NTIS HC A09/MF A01 CSCL 01/2

Improving the safety of complex human-machine systems is a continuing challenge. Available information concerning system failures, which are usually called accidents, incidents, or mishaps, regularly points to human operators as the 'brittle elements.' The need for greater understanding of operator behavior is recognized in a variety of technologically sophisticated systems, for example, industrial processes, health care, public utilities and national defense; but nowhere is it more obvious than in the aftermath of a commerical airline accident. Following the November 1979 crash of an Air New Zealand DC-10 which killed 257 people in Antarctica, United Press International noted that the ten worst disasters in aviation history have all occurred since October 1972. Although the degree of operator culpability varies, the fact that the five deadliest accidents have occurred since March 1974 is particularly significant. At least one commercial airliner was completely destroyed and over 200 people were killed in each of the five crashes. Wide-body jetliners, either Boeing 747 or McDonnell Douglas DC-10 aircraft, were involved in each instance. The sheer size of such vehicles portends grave consequences in case of system failure, be it human mechanical or a combination of the two. GRA

N81-16024# Federal Aviation Administration, Washington, D.C. Office of Aviation Safety.

SPECIAL AVIATION FIRE AND EXPLOSION REDUCTION (SAFER) ADVISORY COMMITTEE, VOLUME 1 Final Report, 26 Jun. 1978 - 26 Jun. 1980

J. H. Enders and E. C. Wood 26 Jun. 1980 86 p refs
(AD-A092016; FAA-ASF-80-4-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 13/12

The Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee and its technical supporting groups spent nearly 13 months from May 1979 through June 1980 examining the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash fire environment and the range of solutions available. Having only a limited amount of time available, the Committee confined its examination to large transport category aircraft reasoning that recommendations developed could provide the necessary guidance for the FAA to address the broader spectrum of airplane and rotorcraft fire safety improvement. During the course of this assignment, certain topics that were outside the scope of the Committee, yet have some bearing on aircraft fire in general, were identified but not discussed by the Committee. Some of these topics were felt to be worthy of further examination by the FAA or by some other body of advisors constituted for that purpose. These topics are not addressed in this report. Presentations were made to the SAFER Committee by Committee members, technical supporting groups, the FAA, citizens and private firms. The broadly-constituted body of information developed and presented to the Committee formed the basis for Committee Findings and Recommendations. The Committee focused its recommendations on solutions or interim improvements. GRA

N81-16025# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

DESIGN, FABRICATION, AND TESTING OF THE MAXIMUM PERFORMANCE EJECTION SYSTEM (MPES) SEAT STRUCTURE

Thomas J. Zenobi and William C. Ward Nov. 1980 106 p
(AD-A092292; NADC-80208-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

Navy has undertaken an effort to utilize an ejection seat structure composed of aluminum honeycomb sandwich composite material. This report documents the design, fabrication procedures and acceptance testing of the seat structure. Due to higher fabrication costs, tradeoffs between strength, weight and cost will have to be addressed. GRA

N81-16026# Rose-Hulman Inst. of Tech., Terre Haute, Ind. Civil and Mechanical Engineering Div.

COMPUTER CODE FOR THE DETERMINATION OF EJECTION SEAT/MAN AERODYNAMIC PARAMETERS Final Report

Donald C. Chiang 28 Aug. 1980 59 p refs
(Grant AF-AFOSR-0147-80; AF Proj. 2307)
(AD-A092721; AFOSR-80-1254TR) Avail: NTIS HC A04/MF A01 CSCL 01/2

The first phase of an effort concerning adaptation of Mark IV computer program (1) as an engineering tool to be used in day-by-day design and development work by the members of Air Crew Escape Group (AFWAL/FIER) was carried out. This research effort consisted of the following two parts: (1) modeling the ejection seat/man configuration, namely, representing its surface with a finite number of rectangular elements and inputting the geometry data of the model into the computer in a format acceptable to the Mark IV computer program, (2) computing the six aerodynamic coefficients using an appropriate pressure law option provided by the Mark IV computer program, and comparing the values predicted by the computer with those obtained from wind tunnel test. A total of five computer models patterned after the models used in wind tunnel test were created. Aerodynamic coefficients were computed for each model over an angle-of-attack range of -40 to 60 degrees and a yaw angle range of 0 to 30 degrees. By adjusting various factors which affect the outcome of computation, an attempt was made to identify an optimum computation method. GRA

N81-16027# Federal Aviation Administration, Washington, D.C. Office of Aviation Safety.

SUMMARY OF AVIATION SAFETY PROGRAM RESUMES. CABIN SAFETY

J. H. Harrison et al Oct. 1980 27 p
(AD-A091938; FAA-ASF-80-3) Avail: NTIS HC A03/MF A01 CSCL 01/2

This report contains a Program Activity Resume and a Project Details listing of those activities supporting the FAA Cabin Safety Program. The Cabin Safety Activity Resume identifies three sub-programs relating to Inflight, Crashworthiness and Post Crash safety activities. The sub-programs are identified and reported in the Project Details listing which includes: Inflight Fire, Operational Hazards, Training Duties, Crash Scenario Definition, Structural Load Analysis, Crashworthy Fuel Tanks, Fuel Fire Hazard, Cabin Interior Materials, Crew Considerations, Crash Rescue, SAFER Advisory Committee and Evacuation Systems. GRA

N81-16028# National Transportation Safety Board, Washington, D. C. Bureau of Technology.

BRIEFS OF FATAL ACCIDENTS INVOLVING WEATHER AS A CAUSE/FACTOR, US GENERAL AVIATION, 1978

5 Aug. 1980 313 p
(PB81-110827; NTSB-AMM-80-5) Avail: NTIS HC A14/MF A01 CSCL 01B

Included are 322 fatal accidents in the brief format. This format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information was tabulated on all accidents involving weather as a cause/factor by types of accident, phase of operation, injury index, aircraft damage, pilots certificate, injuries and cause/factor(s). The publication is published annually. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N81-16029# Naval Postgraduate School, Monterey, Calif.
RADIO DIRECTION FINDING ON HIGH FREQUENCY SHORT DURATION SIGNALS M.S. Thesis
Dennis Dean Sheppard Jun. 1980 175 p refs
(AD-A092136) Avail: NTIS HC A08/MF A01 CSCL 17/3

The feasibility of accomplishing high frequency direction finding against short duration (100-1000 ms) HF skywave signals using narrow aperture antennas is investigated. Two statistical procedures for estimating the signal bearing are proposed and compared. These procedures employ time averaging to reduce the large instantaneous bearing error caused by the phase and amplitude distortion of the wavefront due to scattering and multipath interference. Results are presented using data collected with the Southwest Research Institute Coaxial Spaced Loop HFDF system. It is shown that for a limited sample of data from this system the standard deviation of the bearing estimate for a 200 ms signal varied from 15 to 59 degrees. GRA

N81-16030# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 KHz. VOLUME 1: TECHNICAL APPROACH Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 57 p refs
(Contract DOT-CG-951480-A)
(AD-A092741; TASC-TR-3077-2-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/seasonal times for two usable signal access criteria. Criterion I requires: signal-to-noise ratio (SNR) > or = -20 dB (in a 100 Hz noise bandwidth) and delta phi < or = 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion II differs from Criterion I in that the SNR > or = -30 dB. Volume I presents the diagram development methodology and contains individual station nighttime modal interference diagrams. Each modal interference diagram identifies regions throughout the world where delta phi < or = 20 cec for nighttime propagation conditions. GRA

N81-16031# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 KHz. VOLUME 2: INDIVIDUAL STATION DIAGRAMS Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 72 p 4 Vol.
(AD-A092742; TASC-TR-3077-2-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/seasonal times for two usable signal access criteria. Criterion I requires: signal-to-noise ratio (SNR) = to or < -20 dB (in a 100 Hz noise bandwidth) and delta phi + or - 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion II differs from Criterion I in that the SNR = to or < -30 dB. Volume II presents 64 individual Omega station diagrams (Mercator projection): eight selected coverage times for each of eight stations. Each diagram displays the SNR and delta phi contours for a designated signal access criterion and coverage time. GRA

N81-16032# Analytic Sciences Corp., Reading, Mass.
OMEGA SIGNAL COVERAGE PREDICTION DIAGRAMS FOR 10.2 kHz. VOLUME 4: BEARING ANGLE TABLES Final Report, Sep. 1979 - Oct. 1980
Radha R. Gupta, Stephen F. Donnelly, Paul M. Creamer, and Suzanne Sayer Oct. 1980 56 p 4 Vol.
(Contract DOT-CG-951480-A)
(AD-A092744; , TASC-TR-3077-2-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 17/7

Individual Omega station and composite (Omega Navigation System) 10.2 kHz signal coverage prediction diagrams have been developed for eight times. The diagrams show the global accessibility of 'usable' 10.2 kHz signals at eight fixed diurnal/seasonal times for two usable signal access criteria. Criterion 1 requires: signal-to-noise ratio (SNR) = to or < -20 dB (in a 100 Hz noise bandwidth) and delta phi + or - 20 centicycles (cen), where delta phi is the modal interference-induced phase deviation in the signal phase relative to the reference signal phase. Criterion 2 differs from Criterion 1 in that the SNR = to or < -30 dB. Volume 4 tabulates the bearing angles of great circles to each Omega station. These angles are computed at latitude/longitude grid points having a uniform spacing of four degrees. GRA

N81-16033# Naval Training Equipment Center, Orlando, Fla.
GLIDESLOPE DESCENT-RATE CUING TO AID CARRIER LANDINGS Final Report
Charles E. Kaul, Stanley C. Collyer, and Gavan Lintern Oct. 1980 62 p refs
(AD-A092193; NAVTRAEQUIPC-IH-322) Avail: NTIS HC A04/MF A01 CSCL 01/2

Two techniques for providing descent rate information to pilots making carrier landings were evaluated and shown to be effective in a flight simulator. Landing performance of experienced Naval aviators was tested with a conventional Fresnel lens optical landing system (FLOLS) and with a simple modification to the FLOLS to include variable length vertical light arrays, or arrows. Aircraft system dynamics can create substantial lags between an incorrect control input and the resulting error indication from the FLOLS. The techniques that were evaluated compensated for that lag by providing first order or rate information to the pilot. One system, designated the RATE display, showed the difference between the aircraft's actual descent rate and the descent rate that would maintain its present glideslope angle with respect to the FLOLS. The other, designated the COMMAND display, showed the magnitude of descent rate correction needed, and indicated a no error condition when the pilot was tracking the glideslope or returning to it at an appropriate rate of closure. Both displays improved glideslope tracking performance significantly throughout the approach. Author

N81-16034# Federal Aviation Administration, Atlantic City, N.J.
CONSOLIDATED CAR DISPLAY: A SUMMARY REPORT OF THE PROCESS AND THE RESULTS OF THE CONSOLIDATION OF CRITICAL AND SUPPLEMENTARY TERMINAL AREA AIR TRAFFIC CONTROL INFORMATION FOR DISPLAY PRESENTATION Final Report, Jan. 1978 - Jun. 1979
Gerard Spanier Sep. 1980 49 p refs
(AD-A092450; FAA-CT-80-20; FAA-RD-80-73) Avail: NTIS HC A03/MF A01 CSCL 17/7

This report describes the work performed within the Systems Simulation and Analysis Division, ACT-200, to produce an engineering requirement for a terminal area display system for field implementation by the Airway Facilities Service. The report details the basic project efforts to define a data display system to consolidate many of the Terminal Radar Approach Control Facility (TRACON) and tower cab controller's indicators, displays, alarms, controls, status lights, weather data presentations, etc., to reduce physical size, improve work station efficiency and enhance the management and use of Air Traffic Control (ATC) oriented data. The report covers the data collection process; the requirements determination process; the technology assessment performed; the design development and validation of certain hardware/software components; a risk assessment of the unique aspects of the system design; and the engineering requirement form. GRA

N81-16035# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
FIELD EVALUATION OF THE LR80 LAND NAVIGATION SYSTEM
L. J. Little Apr. 1980 81 p
(AD-A091885; AD-E950035; DRSMI/RG-80-22) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report contains the results of a field evaluation of the Litton Industries LR80 Land Navigation System conducted by the Guidance and Control Directorate at Redstone Arsenal, Al. The overall performance of the system established a north alignment with .021 deg, a position accuracy of .33 percent of the distance traveled and the elevation variation was so great that an accuracy value was not considered. GRA

N81-16036# Human Engineering Labs., Aberdeen Proving Ground, Md.
A PRELIMINARY HUMAN FACTORS FLIGHT ASSESSMENT OF A MARCONI AUTOMATIC MAP Final Report
Thomas L. Frezell Oct. 1980 20 p refs
(AD-A092585; HEL-TN-14-80) Avail: NTIS HC A02/MF A01 CSCL 17/7

A Marconi Automatic Map Reader was flight tested in low level, enroute, and nap-of-the-earth flight profiles to determine its suitability for navigation. The results obtained from these flights demonstrated a viable potential of the Marconi AMR as an interim navigation system. GRA

N81-16037# Sandia Labs., Albuquerque, N. Mex.
A SINGLE GIMBAL/STRAPDOWN INERTIAL NAVIGATION SYSTEM FOR USE ON SPIN STABILIZED FLIGHT TEST VEHICLES
Alfred C. Watts and Ronald D. Andreas 1980 7 p refs Sponsored by DOE
(SAND-80-2479C; CONF-801211-1) Avail: NTIS HC A02/MF A01

A hybrid strapdown inertial navigation system intended for use on spin stabilized flight test vehicles is described. The configuration of the navigator consists of three floated rate integrating gyros, one of which is used in conjunction with the remaining two operated in a rate gyro mode. Outputs from the two strapdown gyros and three accelerometers are digitized and processed by a high performance computer. The navigation algorithms utilize a direction cosine matrix formulation for the attitude computation implemented in the digital computer. The implementation of this algorithm for the single gimbal configuration is described. An accuracy model and results for a reentry vehicle flight test trajectory are presented. Finally, the flight test performance from launch to reentry is presented. M.G.

N81-16038# National Technical Information Service, Springfield, Va.
COLLISION AVOIDANCE SYSTEMS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jul. 1980
Guy E. Habercom, Jr. Aug. 1980 425 p Supersedes NTIS/PS-79/0960; NTIS/PS-78/0883
(PB80-815020; NTIS/PS-79/0960; NTIS/PS-78/0883) Avail: NTIS HC $30.00/MF $30.00 CSCL 01B

Collision avoidance systems in three modes of transportation (i.e. air, surface, marine) are investigated in these research reports. Section 1 pertains to air transportation. Traffic scheduling, automatic ground based stations, and onboard warning systems are researched. Contains 300 abstracts. Section 2 delineates sensors and detectors relative to marine transportation collision avoidance. Contains 68 abstracts. Section 3 relates to engineering research relative to highway and rail collision avoidance. Contains 46 abstracts. This updated bibliography contains 416 citations, 33 of which are new entries to the previous edition. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N81-16039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
USE OF CONSTRAINED OPTIMIZATION IN THE CONCEPTUAL DESIGN OF A MEDIUM-RANGE SUBSONIC TRANSPORT
Steven M. Sliwa Dec. 1980 38 p refs
(NASA-TP-1762; L-13946) Avail: NTIS HC A03/MF A01 CSCL 01C

Constrained parameter optimization was used to perform the optimal conceptual design of a medium range transport configuration. The impact of choosing a given performance index was studied, and the required income for a 15 percent return on investment was proposed as a figure of merit. A number of design constants and constraint functions were systematically varied to document the sensitivities of the optimal design to a variety of economic and technological assumptions. A comparison was made for each of the parameter variations between the baseline configuration and the optimally redesigned configuration. Author

N81-16040*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SAMPLE DATA EFFECTS OF HIGH-PASS FILTERS
David O. Chin Jan. 1981 32 p refs
(NASA-TP-1797; A-8361) Avail: NTIS HC A03/MF A01 CSCL 01C

Four mathematical models of linear first and second order high pass washout filters were analyzed. These models were Euler's Integration, Zero-Order Hold, Bilinear Transformation, and Second-Order Adams-Bashforth Integration. Bode responses for each model at various sample rates were compared to the continuous filter response. Higher sample rates produced Bode responses approaching the continuous response and the Bilinear Transformation model produced the best responses over the frequency spectrum and sample rates. Pole location analysis of each model in the z-plane showed the Bilinear Transformation and Zero-Order Hold models gave stable poles regardless of time step size, whereas the other models did not display stable poles. A near constant gain error over the entire frequency spectrum was discovered in the Zero-Order Hold cases and a correction gain was calculated for the first-order high-pass filter case. S.F.

N81-16041*# Lockheed-Georgia Co., Marietta.
TURBOPROP CARGO AIRCRAFT SYSTEMS STUDY, PHASE 1
J. C. Muehlbauer, James G. Hewell, Jr., Stephen P. Lindenbaum, Charles C. Randall, Norm Searle, and F. Robert Stone, Jr. Nov. 1980 192 p refs
(Contract NAS1-15708)
(NASA-CR-159355; LG80ER0112) Avail: NTIS HC A09/MF A01 CSCL 01C

The effects of advanced propellers (propfan) on aircraft direct operating costs, fuel consumption, and noiseprints were determined. A comparison of three aircraft selected from the results with competitive turbofan aircraft shows that advanced turboprop aircraft offer these potential benefits, relative to advanced turbofan aircraft: 21 percent fuel saving, 26 percent higher fuel efficiency, 15 percent lower DOCs, and 25 percent shorter field lengths. Fuel consumption for the turboprop is nearly 40 percent less than for current commercial turbofan aircraft. Aircraft with both types of propulsion satisfy current federal noise regulations. Advanced turboprop aircraft have smaller noiseprints at 90 EPNdB than advanced turbofan aircraft, but large noiseprints at 70 and 80 EPNdB levels, which are usually suggested as quietness goals. Accelerated development of advanced turboprops is strongly recommended to permit early attainment of the potential fuel saving. Several areas of work are identified which may produce quieter turboprop aircraft. Author

N81-16042*# Boeing Aerospace Co., Seattle, Wash. Engineering Technology.
DESIGN, FABRICATION AND TEST OF GRAPHITE/POLYIMIDE COMPOSITE JOINTS AND ATTACHMENTS FOR ADVANCED AEROSPACE VEHICLES Quarterly Technical Progress Report, 1 Feb. - 30 Apr. 1980
19 May 1980 31 p refs
(Contract NAS1-15644)

(NASA-CR-159112; QTPR-5) Avail: NTIS HC A03/MF A01 CSCL 01C

Principal program activities dealt with the literature survey, design of joint concepts, assessment of GR/PI material quality, fabrication of test panels and specimens, and small specimen testing. Bonded and bolted designs are presented for each of the four major attachment types. Quality control data are presented for prepreg Lots 2W4651 and 3W2020. Preliminary design allowables test results for tension tests and compression tests of laminates are also presented. T.M.

N81-16043# Air Force Academy, Colo. Dept. of Engineering Mechanics.

MODAL ANALYSIS FOR AIRCRAFT RESPONSE TO RUNWAY SURFACE ROUGHNESS Final Report, 1 Jun. 1978 - 30 Jun. 80

Ralph R. Gajewski Jun. 1980 42 p refs
(AF Proj. 2104)
(AD-A092057; AFESC/ESL-TR-80-32) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report develops one and three degree-of-freedom linear vibration models for the prediction of aircraft response to runway surface roughness. The equations of motion are integrated in principal coordinates using modal analysis. The modal parameters required are natural frequency, damping ratio, and mode shape for each degree of freedom. Comparison of results is made with the TAXI code that has a nonlinear strut model. Results are presented for asymmetric motion due to spall profiles in the runway. GRA

N81-16044# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

P-3 ORION FUEL-SAVING MODIFICATION WIND TUNNEL STUDY

Andrew G. Lee Jun. 1980 66 p
(AD-A091906; DTNSRDC/ASED-80/14) Avail: NTIS HC A04/MF A01 CSCL 20/4

A joint investigation was conducted on the potential drag reduction of the P-3 Orion aircraft through various modifications to the engine nacelles. A 1/16-scale model was used in the 7- by 10-foot transonic wind tunnel experiments conducted over an angle of attack range of -4 to 7 deg. Force data were taken on 14 different model configurations with all modifications in the engine nacelle areas. The experiments were conducted as part of the P-3 Fuel-Saving Modifications Program. GRA

N81-16045# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION AH-1S (PROD) HELICOPTER EQUIPPED WITH A SUBSTITUTE STRAIGHT EXHAUST PIPE Final Report

Patrick M. Morris, Ralph Woratschek, John R. Niemann, and Charles E. Frankenberger, Jr. Jun. 1980 36 p
(AD-A092614; USAAEFA-79-09) Avail: NTIS HC A03/MF A01 CSCL 01/3

A limited performance and handling qualities evaluation and an engine and transmission cooling survey of an AH-1S (PROD) Helicopter equipped with a substitute straight exhaust pipe was performed at Edwards Air Force Base between 20 and 23 August 1979. A total of 8 hours, 6.3 of which were productive, was required. No significant changes in performance or handling qualities were found as a result of the substitute straight exhaust pipe installation. The engine and transmission cooling characteristics were similar to those of a production AH-1S and were satisfactory. No previously unreported shortcomings or deficiencies were identified. GRA

N81-16046# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

PRELIMINARY AIRWORTHINESS EVALUATION (PAE 1) OF THE YCH-47D HELICOPTER Final Report, Sep. - Dec. 1979

Grady W. Wilson, Charles F. Adam, Stuart F. Arthur, John R. Niemann, and Frame J. Bowers May 1980 150 p refs
(AD-A092633; USAAEFA-79-06) Avail: NTIS HC A07/MF A01 CSCL 01/3

The Preliminary Airworthiness Evaluation of the YCH-47D helicopter was conducted between 11 September and 6 December 1979. Seventeen flights were required for a total of 41.4 hours, of which 32.8 hours were productive. Testing was conducted at the Boeing Flight Test Facility at Wilmington, Delaware. The YCH-47D exhibits improved lift capability at a hover (both in and out of ground effect) when compared to the CH-47C with fiberglass rotor blades and T55-L-712 engines. Higher airspeeds are also possible at high gross weights. The AFCS was found to be an enhancing characteristic. Twenty shortcomings and one deficiency were also documented during the test. The deficiency of delay in power steering activation should be corrected prior to operational deployment. The noise level in the cockpit and cabin showed no apparent improvement over previous models and was of sufficient magnitude to induce temporary hearing loss without adequate protection. The vibration levels became excessive above 145 KIAS, increasing to unacceptable prior to V sub H, with 6 per rev vibrations being predominant. GRA

N81-16047# Environmental Research Inst. of Michigan, Ann Arbor. Radar and Optics Div.

AN ASSESSMENT OF TECHNICAL FACTORS INFLUENCING THE POTENTIAL USE OF RPVS FOR MINEFIELD DETECTION

Yuji Morita and Henry McKenney Jul. 1980 65 p refs
(Contract DAAK70-78-C-0198)
(AD-A092682; ERIM-138300-57-T) Avail: NTIS HC A04/MF A01 CSCL 17/8

An assessment is made of the use of television and FLIR sensors carried on RPVs as remote minefield detection systems, based on four major scenarios for Soviet mine warfare operations involving the use of TM-46 metallic and PM-60 plastic anti-vehicular mines. The RPV system minefield detection capability, response time and search rate are functions of the sensor resolution, field of view and sensitivity capabilities; the obscuration due to vegetation, atmospheric attenuation, terrain and weather; the radiance contrast existing between mines and background; the airborne platform characteristics; data link characteristics; the man/machine interface; and command, control and communication system characteristics. These factors are considered in this study to initially define the minefield detection capability of currently planned RPVs, to indicate areas where additional data is needed to provide a better definition of RPV minefield detection capabilities and to indicate parameters for an improved next generation sensor system. GRA

N81-15973*# National Aeronautics and Space Administration, Washington, D. C.

HIGH-SPEED COWLINGS, AIR INLETS AND OUTLETS, AND INTERNAL-FLOW SYSTEMS

In its the High-Speed Frontier 1980 p 139-165 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N81-16048# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.

EVALUATION/REDESIGN OF THE F-105 PITCH RATE GYRO PACK

James D. Heck Oct. 1980 10 p
(AFPEA Proj. 80-P7-21)
(AD-A092109; PTPT-80-16) Avail: NTIS HC A02/MF A01 CSCL 13/4

The F-105 Pitch Rate Gyro Pack was subjected to rough handling tests in compliance with Federal Test Method Standard 101B. The objective of this testing was to determine the level of shock protection provided for the Pitch Rate Gyro and to redesign the container if the current pack does not provide a 15 G level of protection, the rated fragility value for the item. It was determined that the pack presently used does not provide the required level of protection, therefore the pack was redesigned to provide a 15 G level of protection. GRA

N81-16049# Systems and Applied Sciences Corp., Riverdale, Md.
A SURVEY OF COMPUTER SIMULATIONS OF DIGITAL AVIONICS SYSTEMS Final Report, 1 Jul. 1979 - 1 Feb. 1980
James Watson, J. Davis, and R. Satterfield Wright-Patterson AFB, Ohio AFWAL Sep. 1980 82 p refs
(Contract F33615-79-C-1870; AF Proj. 2003)
(AD-A091943; AFWAL-TR-80-1057) Avail: NTIS HC A05/MF A01 CSCL 09/2

Three simulation systems (GCSS, DSDS and DAS/DDPM) can meet AFWAL's requirements for flexible, all-software, engineering tool. All factors considered, GCSS can meet those needs best for the short-term, and in so doing, serve as a test vehicle for better definition of AFAL's long-term requirements. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N81-16050*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF FIRST STAGE OF 4-1/2-STAGE, FAN DRIVE TURBINE WITH AVERAGE STAGE-LOADING FACTOR OF 4.66
Warren J. Whitney, Thomas P. Moffitt, and Frank P. Behning Jan. 1981 15 p refs
(NASA-TP-1780; E-461) Avail: NTIS HC A02/MF A01 CSCL 21E

The design procedure and the development of the blading geometry for the 4 and 1/2 stage turbine are discussed. Results obtained with the first stage, operated as a single stage turbine, are presented. A free vortex design meets the design requirements without incurring problems such as excessive turning, negative reaction, or high Mach number. Cold air tests of the single stage turbine showed that the turbine developed design work (stage loading factor of 5.26) at an efficiency of 0.86, which was the efficiency predicted by a reference method. The mass flow at this condition was 0.88, which occurred at design speed and a pressure ratio of 1.407, corresponding to a stage loading factor of 4.35. The efficiency at this condition was 0.003 higher than that predicted by the reference method. Author

N81-16051*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
CORE COMPRESSOR EXIT STAGE STUDY. VOLUME 2: DATA AND PERFORMANCE REPORT FOR THE BASELINE CONFIGURATION
D. C. Wisler Nov. 1980 178 p refs
(Contract NAS3-20070)
(NASA-CR-159498; R80AEG312-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 21E

The objective of the program is to develop rear stage blading designs that have lower losses in their endwall boundary layer regions. The overall technical approach in this efficiency improvement program utilized General Electric's Low Speed Research Compressor as the principal investigative tool. Tests were conducted in two ways: using four identical stages of blading so that test data would be obtained in a true multistage environment and using a single stage of blading so that comparison with the multistage test results could be made. T.M.

N81-16052*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN OVERVIEW OF GENERAL AVIATION PROPULSION RESEARCH PROGRAMS AT NASA LEWIS RESEARCH CENTER
Edward A. Willis and William C. Strack 1981 48 p refs Proposed for presentation at the Natl. Business Aircraft Meeting, 13-15 Apr. 1981, Wichita, Kansas; sponsored by SAE
(NASA-TM-81666; E-686) Avail: NTIS HC A03/MF A01 CSCL 21E

The review covers near-term improvements for current-type piston engines, as well as studies and limited corroborative research on several advanced g/a engine concepts, including diesels, small turboprops and both piston and rotary stratified-charge engines. Also described is basic combustion research, cycle modeling and diagnostic instrumentation work that is required to make new engines a reality. T.M.

N81-16053*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEAN ROTOR WAKE CHARACTERISTICS OF AN AERODYNAMICALLY LOADED 0.5 m DIAMETER FAN
L. M. Shaw and F. W. Glaser 1981 18 p refs Presented at 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by AIAA
(NASA-TM-81657; E-674) Avail: NTIS HC A02/MF A01 CSCL 01A

Mean rotor wake properties at several downstream distances behind the rotor of a loaded 1.2 pressure ratio fan were measured with a cross film anemometer in an anechoic wind tunnel. Mean wake characteristics in the midspan and near tip region were determined utilizing an ensemble averaging technique. The upwash and streamwise components of the velocity behind the rotor indicate a complex structure superimposed on the major velocity defects at a down stream spacing of 0.5 rotor chords. Spectral analysis indicates high levels of the second and fourth harmonics of the blade passage frequency in the midspan region while the blade passage frequency and its second and third harmonic are predominant in the tip region. Author

N81-16054*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL ANALYSIS OF IMEP IN A ROTARY COMBUSTION ENGINE
H. J. Schock, W. J. Rice, and P. R. Meng 1981 44 p refs Presented at Intern. Symp. of Automotive Engr., Detroit, 23-27 Feb. 1981
(NASA-TM-81662; E-680) Avail: NTIS HC A03/MF A01 CSCL 21E

A real time indicated mean effective pressure measurement system is described which is used to judge proposed improvements in cycle efficiency of a rotary combustion engine. This is the first self-contained instrument that is capable of making real time measurements of IMEP in a rotary engine. Previous methods used require data recording and later processing using a digital computer. The unique features of this instrumentation include its ability to measure IMEP on a cycle by cycle, real time basis and the elimination of the need to differentiate volume function in real time. Measurements at two engine speeds (2000 and 3000 rpm) and a full range of loads are presented, although the instrument was designed to operate to speeds of 9000 rpm. Author

N81-16055*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROPULSION SYSTEM MATHEMATICAL MODEL FOR A LIFT/CRUISE FAN V/STOL AIRCRAFT
Gary L. Cole, James F. Sellers, and Bruce E. Tinling (NASA. Ames Research Center) Dec. 1980 48 p refs
(NASA-TM-81663; E-681) Avail: NTIS HC A03/MF A01 CSCL 21E

A propulsion system mathematical model is documented that allows calculation of internal engine parameters during transient operation. A non-realtime digital computer simulation of the model is presented. It is used to investigate thrust response and modulation requirements as well as the impact of duty cycle on engine life and design criteria. Comparison of simulation results with steady-state cycle deck calculations showed good agreement. The model was developed for a specific 3-fan subsonic V/STOL aircraft application, but it can be adapted for use with any similar lift/cruise V/STOL configuration. Author

N81-16056*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TWO-STAGE COMBUSTION FOR REDUCING POLLUTANT EMISSIONS FROM GAS TURBINE COMBUSTORS
Richard M. Clayton and David H. Lewis 1 Feb. 1981 86 p refs
(Contract NAS7-100)
(NASA-CR-163877; JPL-Pub-80-63) Avail: NTIS HC A05/MF A01 CSCL 21E

Combustion and emission results are presented for a premix combustor fueled with admixtures of JP5 with neat H2 and of JP5 with simulated partial-oxidation product gas. The combustor was operated with inlet-air state conditions typical of cruise power for high performance aviation engines. Ultralow NOx, CO and HC emissions and extended lean burning limits were achieved simultaneously. Laboratory scale studies of the non-catalyzed rich-burning characteristics of several paraffin-series hydrocarbon fuels and of JP5 showed sooting limits at equivalence ratios of about 2.0 and that in order to achieve very rich sootless burning it is necessary to premix the reactants thoroughly and to use high levels of air preheat. The application of two-stage combustion for the reduction of fuel NOx was reviewed. An experimental combustor designed and constructed for two-stage combustion experiments is described. T.M.

N81-16057*# Avco Lycoming Div., Stratford, Conn.
DESIGN AND EVALUATION OF AN INTEGRATED QUIET CLEAN GENERAL AVIATION TURBOFAN (OCGAT) ENGINE AND AIRCRAFT PROPULSION SYSTEM Final Report, Dec. 1976 - Apr. 1980
Jon German, Philip Fogel, and Craig Wilson Apr. 1980 226 p refs
(Contract NAS3-20584)
(NASA-CR-165185; LYC-80-27) Avail: NASA Industrial Application Center CSCL 21E

The engine and nacelle system design was to demonstrate the applicability of large turbofan engine technology to small turbofans suitable for the general aviation market. The design was based on the LTS-101 engine family for the core engine. A high bypass fan design (BPR=9.4) was incorporated to provide reduced fuel consumption for the design mission. All acoustic and pollutant emissions goals were achieved. A discussion of the preliminary design of a business jet suitable for the developed propulsion system is also included. Large engine technology can be successfully applied to small turbofans, and noise or pollutant levels need not be constraints for the design of future small general aviation turbofan engines. T.M.

N81-16058*# Mississippi State Univ., Mississippi State. Engineering and Industrial Research Station.
PROPELLER PROPULSION INTEGRATION, PHASE 1 Final Report
George Bennett, Keith Koenig, Stan J. Miley, John McWhorter, and Graham Wells Feb. 1981 131 p refs
(Grant NsG-1402)
(NASA-CR-163921; MSSU-EIRS-ASE-81-4) Avail: NTIS HC A07/MF A01 CSCL 01C

A bibliography was compiled of all readily available sources of propeller analytical and experimental studies conducted during the 1930 through 1960 period. A propeller test stand was developed for the measurement of thrust and torque characteristics of full scale general aviation propellers and installed in the LaRC 30 x 60 foot full scale wind tunnel. A tunnel entry was made during the January through February 1980 period. Several propellers were tested, but unforseen difficulties with the shaft thrust torque balance severely degraded the data quality. T.M.

N81-16059# Solar Turbines International, San Diego, Calif.
COMBINED CYCLE STEAM GENERATOR GAS SIDE FOULING EVALUATION, PHASE 2 Final Report
P. B. Roberts and A. J. Kubasco Sep. 1980 32 p refs
(Contract N00024-77-C-4366)
(AD-A092797) Avail: NTIS HC A03/MF A01 CSCL 21/5

Liquid-fueled gas turbines can produce serious steam generator fouling in gas turbine combined cycle applications and other waste heat recovery systems as a result of combustion system generated soot particles. In addition, standard soot blowing practices are not always compatible with the advanced, compact matrix designs sometimes required for minimum package size applications. In Phase 1, an experimental program was conducted on both test rigs and engine hardware designed to evaluate the effects on gas side soot fouling rates of various operational parameters such as soot loading, temperature, and velocity. Results showed that the self-cleaning concept, whereby soot deposits are removed by curtailing steam generator water flow and raising fin/tube temperatures to that of the prevailing exhaust gas, is a viable alternative to standard soot-blowing practice. The results, however, also showed inconsistencies in the self-cleaning threshold temperature between the various rigs. Phase 2 of this program was conducted to resolve these inconsistencies and, more specifically, to define a cleaning schedule for a LM-2500 combined cycle. The results lend further support to the self-cleaning concept and show that at full load a LM-2500 combined cycle system would be expected to clean itself within an hour after dryout. GRA

N81-16060# Naval Postgraduate School, Monterey, Calif.
VALIDATION OF A TWO DIMENSIONAL PRIMITIVE VARIABLE COMPUTER CODE FOR FLOW FIELDS IN JET ENGINE TEST CELLS M.S. Thesis
Paul Joseph Mallon Jun. 1980 76 p refs
(AD-A092138) Avail: NTIS HC A05/MF A01 CSCL 21/5

Pressure and velocity data were collected in a full scale jet engine test cell in order to validate the predictive accuracy of a two dimensional and axisymmetric primitive variable computer code. It was found that the model reasonably predicted the velocity profiles in the augmentor tube. Inaccuracy increased at higher engine thrust settings at positions far downstream in the augmentor tube. Predicted pressure profiles were reasonable but the magnitudes were in considerable error at high flow rates. GRA

N81-16061# Purdue Univ., Lafayette, Ind. Combustion Lab.
AGT-1500 COMBUSTOR AND FUEL ELLECTS MODELING Final Technical Report, 1 Sep. 1978 - 31 Aug. 1980
P. A. Leonard, J. E. Peters, and A. M. Mellor 1 Oct. 1980 72 p refs
(Contract DAAG29-79-C-0169; Grant DAAG29-78-G-0092)
(AD-A092255; PURDU-CL-80-03; ARO-15642.5-E) Avail: NTIS HC A04/MF A01 CSCL 21/5

The influence of alternative fuels on gas turbine engine performance is considered analytically. Broad specification or alternative fuels may have viscosities and wider boiling point temperature distributions which adversely affect atomization and vaporization processes within gas turbine combustors, leading to performance penalties in ignition, lean blowoff and combustion efficiency. These performance measures have been modeled by considering ratios of characteristic times which describe the controlling physical processes of fluid mechanic mixing, kinetics and fuel evaporation. Semi-empirical models are developed which describe lean blowoff, ignition and combustion efficiency of the AVCO-Lycoming AGT-1500 combustor and other combustors. These expressions can be used to assist design of fuel tolerant combustors, and to assess impacts associated with fuel type selection. GRA

N81-16062# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
NONLINEAR ANALYSIS OF SQUEEZE FILM DAMPERS APPLIED TO GAS TURBINE HELICOPTER ENGINES Final Report, 15 Jan. 1977 - 31 May 1980
E. J. Gunter, L. E. Barrett, and P. E. Allaire Nov. 1980 13 p
(Contract DAAG29-77-C-0009)
(AD-A091905; ARO-14100.1-E) Avail: NTIS HC A02/MF A01 CSCL 21/5

Application of the finite length correction factor for the analysis of the finite length squeeze film bearings has been made, and a method has been found to be highly efficient. The modal transient program, to include linear rotor acceleration, has been developed and various analyses of rotor systems have been done. A rapid method to calculate the load capacity and dynamics characteristics of a journal or squeeze film bearing has been developed using a finite element approach coupled with an end leakage correction factor. A procedure has been developed to balance a multistage turbine without having to first apply trial weights to generate a set of influence coefficients. This procedure represents a major advance in the technology of flexible rotor balancing. It

is incorporated into a minicomputer system which can collect and analyze the rotor data. GRA

N81-16063# Calspan Advanced Technology Center, Buffalo, N.Y.
NUCLEAR BLAST RESPONSE OF AIRBREATHING PROPULSION SYSTEMS. LABORATORY MEASUREMENTS WITH AN OPERATIONAL J-85-5 TURBOJET ENGINE Final Report, 1 Feb. 1979 - 31 Mar. 1980
Michael G. Dunn 31 Mar. 1980 67 p refs
(Contract DNA001-79-C-0155)
(AD-A092229; CALSPAN-6486-A-1; DNA-5268F) Avail: NTIS HC A04/MF A01 CSCL 21/5

The work discussed in this report represents a technology development program in which an experimental technique has been developed for the performance of controlled laboratory measurements of simulated nuclear blast response of airbreathing propulsion systems. The technology program utilized an available J-85-5 turbojet engine located in the test section of the Calspan Ludwieg-tube facility. Significant modifications, described herein, were made to this facility in order to adapt it to the desired configuration. The J-85-5 engine had previously been used at Calspan for other purposes and thus came equipped with a total of eight pressure transducers at four axial locations along with compressor section. These transducers have a frequency response on the order of 40 KHz. Preliminary comparisons have been made between the measured pressure histories at selected compressor locations and predicted pressure histories using a simple computer code. The development of the code was initiated under this contract and completed as part of an ongoing IR D effort at Calspan in computational fluid dynamics and problem areas related to engine dynamics. GRA

N81-16064# Federal Aviation Administration, Atlantic City, N.J.
EXHAUST EMISSION CHARACTERISTICS AND VARIABILITY FOR MAINTAINED GENERAL ELECTRIC CF6-50 TURBOFAN ENGINES Final Report, Jul. - Oct. 1979
Gary Frings Sep. 1980 57 p refs
(FAA Proj. 201-521-100)
(AD-A092291; FAA-CT-80-36) Avail: NTIS HC A04/MF A01 CSCL 21/5

Five General Electric (GE) CF6-50 turbofan engines were tested at the GE overhaul facility in Ontario, California, to quantify and determine the variability of the exhaust emission levels. The effects of heavy maintenance on these emission levels were also studied. Only two of the engines tested actually received major maintenance. Consequently, the data collected is limited in quantity. Conclusions, observations and recommendations are presented based on this limited data base. No correlation of exhaust emission levels and type of maintenance was possible. The exhaust emission levels of carbon monoxide (CO) and oxides of nitrogen (NOx) have been determined; total hydrocarbon (THC) levels are not quantified. The variability of the CO and NOx species is less than five percent. THC variability is almost 30 percent. The engine emissions did not meet the current or proposed federal standards. Ninety percent of the turbine engine exhaust emissions are produced at the idle power mode. The operational parameters for this important (from the standpoint of emission data collection) mode are vague and should be more defined. The type of fuel used for emission testing has a significant effect on the resultant exhaust emission levels. GRA

N81-16065# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
THREE DIMENSIONAL INTERNAL FLOWS IN TURBOMACHINERY, VOLUME 1 Final Report, Jan. 1978 - Jun. 1980
Awatef A. Hamed Jun. 1980 51 p refs
(Contract F49620-78-C-0041; AF Proj. 2307)
(AD-A092737; AFOSR-80-1214TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

This report describes an efficient numerical scheme developed for investigating secondary flows, and outlines the design of an experimental set-up for obtaining detail in channel three dimensional secondary flow measurements. The analysis applies to inviscid internal rotational flow fields and leads to a very efficient numerical scheme for predicting the secondary flow phenomena. The analysis is applied to the rotational flow in a 90 deg bend with rectangular cross section and then compared with the experimental data. It is concluded from the comparison that the physics of the secondary flow problem are well represented in the analysis. The analysis can be adapted with some modifications to variable area ducts, and turbomachinery passages. GRA

N81-15972*# National Aeronautics and Space Administration, Washington, D. C.
THE HIGH-SPEED PROPELLER PROGRAM
In its The High-Speed Frontier 1980 p 119-138 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 01A

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N81-16066*# Kansas Univ. Center for Research, Inc., Lawrence.
THE STATE OF THE ART OF GENERAL AVIATION AUTOPILOTS
Michael J. See and David Levy Aug. 1980 95 p refs
(Contract NAS1-16255)
(NASA-CR-159371) Avail: NTIS HC A05/MF A01 CSCL 01C

The study is based on the information obtained from a general literature search, product literature, and visitations and interviews with manufacturers, users, and service centers. State of the art autopilots are documented with respect to total systems, components, and functions. Recommendations concerning potential areas of further research are also presented. T.M.

N81-16067# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Industrial Engineering.
THE EFFECTS OF THE DIRECTION OF CONTROL LOADING ON A ONE-DIMENSIONAL TRACKING TASK M.S. Thesis - Georgia Institute of Technology
James Michael Carlin Mar. 1980 70 p refs
(AD-A092459; AFIT-CI-80-10T) Avail: NTIS HC A04/MF A01 CSCL 01/2

Modern fighter aircraft flight controls are activated by the pilot through a joystick. Because of heavy loads on the control surfaces, the flight controls are finally actuated by powerful hydraulic actuators. Artificial feel systems of varying complexity are utilized to give some feedback to the pilot to aid in control. Regardless of the system, virtually all are equipped with thumb-actuated pitch and roll trim. This feature allows the pilot to quickly and easily change the fore and aft or lateral stick force required to control the pitch and roll of the aircraft. During precise tracking tasks such as flying close formation maneuvers, or tracking an air or ground target in an aiming device, many pilots desire to trim the stick forward. A smaller proportion constantly strive for zero pressure in a precise tracking situation. Virtually none trim aft stick pressure in this environment. This study is strictly concerned with uni-directional control loading. GRA

N81-16068# Grumman Aerospace Corp., Bethpage, N.Y.
DEMONSTRATION OF A METHOD FOR DETERMINING CRITICAL STORE CONFIGURATIONS FOR WING STORE FLUTTER Final Report
Richard R. Chipman and Edward J. Laurie May 1980 132 p refs
(Contract N00019-79-C-0062)
(AD-A092257; ADCR-80-1) Avail: NTIS HC A07/MF A01 CSCL 20/4

The A-6E aircraft and its extensive store inventory were analyzed. Searches of the inventory singled out the potentially critical configurations that gave flutter speeds well within the flight envelope for low assumed values of structural damping. Comparisons were made with previous results from A-6 studies and possible explanations for the apparent anomaly were explored. The method offers an efficient alternative to existing practices

for determining potentially flutter critical store combinations from the many thousands of store loadings that can occur on attack aircraft. T.M.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N81-16069# European Space Agency, Paris (France).
GRAVIMETRIC INVESTIGATION OF THE PARTICLE NUMBER DENSITY DISTRIBUTION FUNCTION IN THE HIGH SPEED CASCADE WIND TUNNEL FOR LASER ANEMOMETRY MEASUREMENTS
Harro Bessling and Torsten Hinz Sep. 1980 34 p refs Transl. into ENGLISH of "Gravimetrische Untersuchung der Partikelzahldichteverteilungsfunktionen im Hochgeschwindigkeits Gitterwindkamal fuer laser anemometrische Messungen", DFVLR-FB 79-12, Brunswick, Jan. 1979 38 p Original report in GERMAN previously announced as X80-75089 Original German report available from DFVLR, Cologne DM 8,50
(ESA-TT-625; DFVLR-FB-79-12) Avail: NTIS HC A03/MF A01

Laser anemometry requires a minimum concentration of scattering particles in the flow. Before an L2F velocimeter could be used, the natural dust content in the low pressure tank of the high speed cascade wind tunnel had to be evaluated for this type of measurement. A Coulter counter was used for the necessary dust analysis by the gravimetric method. The result showed that the behavior of the particle number density distribution functions is dynamic and particularly dependent upon the flow velocity. A self cleaning effect, which is very important for laser anemometry, was found to make the tunnel dust free in the minimum amount of time, and a model concept was developed to explain the loss mechanism. Author

N81-16070# IIT Research Inst., Chicago, Ill. Guidance and Control Information and Analysis Center.
EVALUATION OF RF ANECHOIC CHAMBER FIRE PROTECTION SYSTEMS Final Report
Thomas E. Waterman, John A. Campbell, Larry D. Paarmann, Irving N. Indel, and Charles W. Smoots Jul. 1980 177 p refs
(Contract DSA900-77-C-3840)
(AD-A092478; AD-E900032; GACIAC-SR-80-02; NWC-TP-6211) Avail: NTIS HC A09/MF A01 CSCL 14/2

The increasing use of microwave anechoic chambers plus several recent chamber fires was the impetus for this special study. The report identifies and collects in one document the various issues and problems associated with the fire protection of anechoic chambers. It also addresses the interfaces between personnel groups including the chamber designers, operators, maintenance and the fire department. It is not a design report; i.e., it does not contain enough detail to design either a chamber or the fire protection system. Instead, it presents the pros and cons of the various fire protection options available to the designers (smoke and heat detectors, alarm systems, sprinkler heads, preferred physical locations, fire suppressant agents, etc.) and relates these to the chamber operation. The report also identifies several areas where additional investigation is required such as detection of deep-seated combustion, testing of new more fire-resistant absorber materials, and analysis of the combustion products of halogen-type suppressants. An extensive list of references is included. GRA

N81-16071# Oklahoma State Univ., Stillwater. School of Civil Engineering.
POTENTIAL USE OF GEOTECHNICAL FABRIC IN AIRFIELD RUNWAY DESIGN Final Report
T. Allen Haliburton, Jack D. Lawmaster, and John K. King Oct. 1980 130 p refs
(Contract AF-AFOSR-0087-79; AF Proj. 2307)
(AD-A092686; AFOSR-80-1192TR) Avail: NTIS HC A07/MF A01 CSCL 13/3

A state-of-the-art literature review and laboratory experimental study of the mechanisms of geotechnical fabric separation and lateral restraint reinforcement were performed. Fabrics of dissimilar physical properties were evaluated for use in lateral restraint reinforcement of a cohensionless soil mass. Though considerable increases in strength and load-deformation modulus were obtained for the fabric-reinforced soil systems, no significant difference in behavior was noted among the four fabrics tested, despite wide variations in their physical properties. Fabric prestressing had little effect on behavior. Lateral restraint reinforcement occurred as a result of fabric interference with development of zones of radial shear, underneath and adjacent to the loaded area. The effect is to produce horizontal restraint and confinement, which increases the applied soil stress necessary to develop plastic equilibrium and increases the initial deformation modulus and ultimate load capacity of the system. Lateral confinement induces initial elasto-plastic behavior of the reinforced mass which approximates the classic general shear failure conditions postulated by Terzaghi. An optimum depth of placement for fabric was determined which provides maximum deformation modulus and initial strength and minimizes soil yielding necessary to develop strain hardening effects. The optimum depth is related to the width of the loaded contact area and frictional properties of the reinforced soil. GRA

N81-16072# Canyon Research Group, Inc., Westlake Village, Calif.
CRITICAL RESEARCH ISSUES AND VISUAL SYSTEM REQUIREMENTS FOR A V/STOL TRAINING RESEARCH SIMULATOR Final Technical Report, 15 Jun. 1978 - 14 Jun. 1979
Robert T. Hennessy, Dennis J. Sullivan, and Herbert D. Cooles Oct. 1980 153 p refs
(Contract N61339-78-C-0076)
(AD-A092561; RTH-0180; NAVTRAEQUIPC-78-C-0076-1) Avail: NTIS HC A08/MF A01 CSCL 14/2

Critical research issues for Vertical/Short Takeoff and Landing (V/STOL) flight simulator visual systems and the functional requirements for a visual system necessary to support the research were developed. It was concluded from analyses of mission and training requirements that the V/STOL unique tasks, those performed during thrust-borne flight, are the most likely candidates for simulator training. A task analysis was subsequently performed for these tasks to determine the visual information requirements. It became apparent, however, that there is no logical way to derive displayed scene requirements from the information requirements and what is known about visual perception. Consideration of general visual requirements for flying, the ecological role of visual perception and the purpose of flight training in a simulator, led to the formulation of four categories of critical research issues. These four categories are: (1) scene content, (2) perceptual learning, (3) use of visual augmentation, and (4) display characteristics. GRA

N81-16073# IIT Research Inst., Chicago, Ill.
SHIELDED ENCLOSURE TEST BED REQUIREMENT Final Report, 29 Jan. 1979 - 29 Feb. 1980
L. Valcik 30 Apr. 1980 40 p refs
(Contract DNA001-79-C-0205)
(AD-A092589; DNA-5341F) Avail: NTIS HC A03/MF A01 CSCL 14/2

A shielded enclosure Test Bed Facility is recommended for obtaining data relating EMP shield design to the internal fields and internal cable coupling. The facility should accommodate a shielded enclosure approximately 10 ft high x 20 ft wide x 50 ft long, to study a variety of shield design parameters, e.g., shield panel material and thickness, joint construction, and penetrant configurations. It should provide for excitation by CW injected current and a radiated pulse. Several analytical and laboratory tasks are recommended in support of the test bed experiments. GRA

N81-15971*# National Aeronautics and Space Administration, Washington, D. C.
TRANSONIC WIND TUNNEL DEVELOPMENT (1940 - 1950)

In its The High-Speed Frontier 1980 p 61-118 (For primary document see N81-15969 07-01)
Avail: NTIS MF A01; SOD HC $6.50 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N81-16074* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THE ORBITAL FLIGHT TEST PROGRAM
5 Nov. 1980 112 p
(P80-10216) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

The construction of the program is described and the first four flights are discussed. Flight requirements and flight planning were reviewed. The payload for each of the flights is described. Abort trajectories for all phases of flight were examined. T.M.

N81-16075*# National Aeronautics and Space Administration, Washington, D. C.
MATERIALS PROCESSING IN SPACE: EARLY EXPERIMENTS
Robert J. Naumann and Harvey W. Herring 1980 123 p Original contains color illustrations
(NASA-SP-443; LC-80-607081) Avail: NTIS MF A01; SOD HC $10.00 CSCL 22A

The characteristics of the space environment were reviewed. Potential applications of space processing are discussed and include metallurgical processing, and processing of semiconductor materials. The behavior of fluid in low gravity is described. The evolution of apparatus for materials processing in space was reviewed. T.M.

N81-16076*# Scientific Translation Service, Santa Barbara, Calif.
PROBLEMS OF SPACE PRODUCTION
V. S. Avduyevskiy, I. V. Barmin, S. D. Grishin, L. V. Leskov, A. M. Petrov, V. I. Polezhayev, and V. V. Savichev Dec. 1980 264 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskogo Proizvodstva" Moscow, Machinostroyeniye Press, 1980 p 1-221 Translated by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-3198)
(NASA-TM-76418) Avail: NTIS HC A12/MF A01 CSCL 22A

Theoretical principles are presented for the production of materials in space. Conditions are examined for conducting technological processes on board space vehicles in weightlessness. Principles are analyzed for planning experimental equipment to process materials in space. A classification, the current condition and outlook for conducting research in the main fields of the space industry are given. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N81-16077# Air Force Geophysics Lab., Hanscom AFB, Mass. Meteorology Div.
HORIZONTAL SCALE VARIATIONS IN SATELLITE ESTIMATES OF WEATHER EROSION PARAMETERS FOR REENTRY SYSTEMS
James T. Bunting and Chankey N. Touart 26 Jun. 1980 30 p
(AF Proj. 6670)
(AD-A092447; AFGL-TR-80-0209; AFGL-AFSG-428) Avail: NTIS HC A03/MF A01 CSCL 16/3

A weather erosion parameter known as the Environmental Severity Index (ESI) has been estimated using infrared and visible data from satellites. Cloud sampling requirements limited the original prediction equations to satellite data averaged over a horizontal scale of 70 km. Further experiments have demonstrated great utility for satellite estimates on a scale of 10 km and also revealed some systematic differences between the coarse and the fine scale estimates. The ESI averages 1 percent to 10 percent higher for the fine scale estimates and high values of ESI are observed more frequently. GRA

N81-16078# Sandia Labs., Albuquerque, N. Mex.
VARIABLE NODE DRAG PARAMETERIZATION FOR REENTRY TRAJECTORY ESTIMATION
Ronald W. Greene and Walton E. Williamson, Jr. 1980 6 p refs Sponsored by DOE
(SAND-80-1515C; CONF-800151-1) Avail: NTIS HC A02/MF A01

A numerical parameter optimization technique was used to determine the piecewise continuous polynomial approximation to the drag coefficient history that produces a reentry trajectory that best matches radar data in a weighted least squares sense. The drag coefficient was parameterized in terms of node point locations, and polynomial coefficients or function values at the nodes. Estimation of node locations for drag coefficient histories using simulated radar data reduced data residuals by almost one half through improved approximation of the sharp rise in drag coefficient caused by boundary layer transition. T.M.

N81-16079# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
ORBITAL MECHANICS AND ANALYTIC MODELING OF METEOROLOGICAL SATELLITE ORBITS. APPLICATIONS TO THE SATELLITE NAVIGATIONAL PROBLEM
Eric A. Smith Feb. 1980 168 p refs
(Contract N00014-79-C-0793; Grants NSF ATM-78-07148; NSF ATM-78-20375)
(CSU-ATSP-321) Avail: NTIS HC A08/MF A01

Using the invariant two body Keplerian orbit as the basis of discussion, an analytic approach used to model the orbital characteristics of near Earth satellites is presented. The basic concepts involved with satellite navigation and orbit mechanics are defined. In addition, the various measures of time and coordinate geometry were reviewed. The two body problem was then examined beginning with the inverse square force field law. The mathematical analysis of a procedure used to calculate celestial position vectors of a satellite is described. It was shown that a transformation of Kepler's time equation to an expansion in powers of eccentricity removes the need for numerical approximation. T.M.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N81-16080*# Howard Univ., Washington, D. C.
STUDY OF FOLDABLE ELASTIC TUBES FOR LARGE SPACE STRUCTURE APPLICATIONS Final Report, Feb. - Dec. 1980
Irving W. Jones and Caster D. Williams Jan. 1981 46 p refs (Grant NsG-1320)
(NASA-CR-163886) Avail: NTIS HC A03/MF A01 CSCL 22B

Various modifications were made to the tube design. The tubes were retested and analyzed, and the results are presented. One type of modified tube, the slotted tube, deployed successfully and reliably, and became the focus of detailed tests. Optimal design criteria, taking into consideration deployment as well as strength and buckling behavior were established. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N81-16081 Ohio State Univ., Columbus.
OPTIMAL AND SUBOPTIMAL TERMINAL GUIDANCE LAWS WITH PRACTICAL CONSIDERATIONS FOR A SHORT RANGE MISSILE AGAINST AN ACCELERATING TARGET Ph.D. Thesis
Carlton James Bates 1980 352 p
Avail: Univ. Microfilms Order No. 8100112

Optimal and suboptimal closed loop guidance laws are developed and evaluated for short range homing missile against an accelerating target. Two dimensional kinematics are assumed for the missile to target motion. The missile is modeled as a second order underdamped system (lateral acceleration response) with time varying velocity and longitudinal acceleration characteristics. The target acceleration is included as a generalized function with an instantaneous response. Linear optimal control theory is used to derive an optimal terminal guidance law. Statistical and terminal homing performance evaluations are completed for proportional navigation and the guidance laws developed in the study. Characteristics of a realistic test missile along with error sources representative of a radar seeker are defined and modeled. Homing performance of the suboptimal law closely approximates that of the optimal. Dissert. Abstr.

N81-16082# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT ON THE 30TH GUIDANCE AND CONTROL PANEL TECHNICAL MEETING: SYMPOSIUM ON GUIDANCE AND CONTROL ASPECTS OF TACTICAL AIR-LAUNCHED MISSILES
J. M. Gonzalez (General Research Co., Fort Walton Beach, Fla.) Oct. 1980 15 p refs Symp. held at Eglin AFB, Fla., 6-9 May 1980
(AGARD-AR-154) Avail: NTIS HC A02/MF A01

The evaluation is an assessment and integration of the individual technical presentations, the discussions which followed each presentation, the round table discussion, and the written comments made by the symposium attendees on the evaluation forms. Detailed technical objectives were established for each session based on the symposium theme and remarks made in the keynote address, and then compared with the collective content of each session to establish the area where the objectives were and were not met. T.M.

N81-16083*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LAUNCH MISSION SUMMARY: COMSTAR D-4 ATLAS/CENTAUR-42
12 Feb. 1981 11 p
(NASA-TM-82236; KSC-GP-15-15) Avail: NTIS HC A02/MF A01 CSCL 22B

Information relative to launch windows, flight plan, and radar and telemetry coverage is presented. Also included is selected trajectory information and a brief sequence of light events. T.M.

N81-16084*# Old Dominion Univ., Norfolk, Va. Dept. of Physics.
RADIATION STUDIES OF OPTICAL AND ELECTRONIC COMPONENTS USED IN ASTRONOMICAL SATELLITE STUDIES Final Report, period ending 31 Jul. 1980
Jacob Becher and R. L. Kernell Jan. 1981 106 p refs
(Grant NsG-5053)
(NASA-CR-163873; PTR-81-1) Avail: NTIS HC A06/MF A01 CSCL 22B

The synchronous orbit of the IUE carries the satellite through Earth's outer electron belt. A 40 mCi Sr90 source was used to simulate these electrons. A 5 mCi source of Co60 was used to simulate bremmstrahlung. A 10 MeV electron Linac and a 1.7 MeV electron Van de Graaf wer used to investigate the energy dependence of radiation effects and to perform radiations at a high flux rate. A 100 MeV proton cyclotron was used to simulate cosmic rays. Results are presented for three instrument systems of the IUE and measurements for specific components are reported. The three instrument systems were the ultraviolet converter, the fine error sensor (FES), and the SEC vidicon camera tube. The components were optical glasses, electronic components, silicon photodiodes, and UV window materials. T.M.

N81-16085*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR POWER SATELLITE COST ESTIMATE
Ronald J. Harron and Richard C. Wadle Jan. 1981 169 p refs
(NASA-TM-58231; JSC-17053) Avail: NTIS HC A08/MF A01 CSCL 22B

The solar power configuration costed is the 5 GW silicon solar cell reference system. The subsystems identified by work breakdown structure elements to the lowest level for which cost information was generated. This breakdown divides into five sections: the satellite, construction, transportation, the ground receiving station and maintenance. For each work breakdown structure element, a definition, design description and cost estimate were included. An effort was made to include for each element a reference that more thoroughly describes the element and the method of costing used. All costs are in 1977 dollars. T.M.

N81-16086# European Space Agency, Paris (France).
DETERMINATION OF BOUNDARIES FOR KINEMATIC INTERCEPT REGIONS AND EVALUATION OF THE MISS DISTANCE FOR LINE-OF-SIGHT (LOS)-GUIDED MISSILES
Winfried Hofmann Sep. 1980 77 p refs Transl. into ENGLISH of "Zur Ermittlung kinematischer Treffbereichsgrenzen u. zur Abschaetzung der Flugkoerperablage beim Zieldeckungskurs (ZDI)" DFVLR, Oberpfaffenhofen, West Germany Rept. DFVLR-FB 79-13, Mar. 1979 Original report in GERMAN previously announced as X80-74979
(ESA-TT-626; DFVLR-FB-79-13) Avail: NTIS HC A05/MF A01; Original German report available from DFVLR, Cologne DM 15,40

The splitting of the LOS-guidance law in a feed forward and feedback portion allows a separate consideration of the kinematic and dynamic behavior of the guidance loop. Requirements on the lead (trajectory-to-beam) - angle and the lateral acceleration of the missile can be deduced from the kinematic equations of motion. Taking into consideration a maximum value of admissible lead angle and the constraints of lateral acceleration capability the boundaries of kinematic intercept regions are presented. The performance of miss distance behavior due to missile dynamics and initial errors can be evaluated using a linearized time-varying dynamic deviation model. Author

N81-16087# Aerospace Corp., El Segundo, Calif. Programs Group.
COST ESTIMATING PROCEDURE FOR UNMANNED SATELLITES Final Report
H. Greer and H. G. Campbell Nov. 1980 20 p
(Contract F04701-80-C-0081)
(AD-A092458; TR-0081(6910)-1) Avail: NTIS HC A02/MF A01 CSCL 22/2

Historical costs from 11 unmanned satellite programs were analyzed. From these data, total satellite cost estimating relationships (CERs) were developed for use during preliminary design studies. A time-related factor, which it is believed accounts for differences in technology, was observed in the data. Stratification of the data by type of payload was also found to be necessary. Cost differences that stem from production quantity variations were accounted for by adjustment factors developed from standard learning curve theory. An example to illustrate use of the CERs is provided. GRA

N81-16088# General Electric Co., Lanham, Md. Space Div.
ADVANCED SATELLITE HARDWARE/SOFTWARE SYSTEM STUDY
R. Spencer, R. Ho, F. Kabat, D. M. Smith, and R. Fries 15 Apr. 1980 237 p refs
(Contract DAAK70-79-C-0009)
(AD-A091959; GE80SDS4213; ETL-0225) Avail: NTIS HC A11/MF A01 CSCL 22/2

This report provides an overview of the LANDSAT-D program and the anticipated requirements of the Corps of Engineers for the application of LANDSAT data to operational programs. A general discussion of the candidate data analysis requirements, including data input and output and other data preparation processes, provides a complete description of the capabilities which will be required of an advanced satellite hardware/software image analysis system. A brief overview of the currently available hardware technology provides a basis for the synthesis of the hardware system design and an example of a typical software structure, based on that for an actual system, is presented. Descriptions of three candidate system architectures provide examples of different approaches to the development of a system meeting the Corps of Engineers requirements and the problems of communication between remoted terminals and a host processor are addressed together with the problems related to the dissemination of data to remotely located independent systems. A brief cost analysis indicates the system cost drivers and shows how cost tradeoffs may be made in developing a specific system. A candidate system design for the Corps of Engineers is presented based on the concept of independent systems with capabilities tailored to local requirements. GRA

N81-16089# Boston Coll., Chestnut Hill, Mass. Space Data Analysis Lab.

ATMOSPHERIC EFFECTS ON THE TIME-VARYING PHOTOELECTRON FLUX FROM SATELLITE SURFACES Scientific Interim Report

J. M. Forbes and H. B. Garrett 16 Jun. 1980 35 p refs (Contract F19628-79-C-0031; AF Proj. 7661)
(AD-A092446; AFGL-TR-80-0185; AFGL-ERP-706) Avail: NTIS HC A03/MF A01 CSCL 22/2

Satellites in geosynchronous orbit have been found to vary rapidly in potential as they pass into the Earth's shadow. The cause of this effect is known to be the loss of the photoelectron flux from the satellite surface. A material-dependent model of this emission process based on detailed models of the attenuation of the sunlight and the photoelectron emission as a function of wavelength will be presented. The model is found to agree in detail with actual measurements of photoelectron emission from tungsten. The computer code included in the Appendix is readily adaptable to a number of materials and situations where the detailed absorption of sunlight as a function of altitude is required. GRA

N81-16090# Air Force Geophysics Lab., Hanscom AFB, Mass.

DESIGN OF A UNIQUE AZIMUTH MONITORING DEVICE Interim Report

T. E. Wirtanen and B. M. Mertz 10 Nov. 1980 16 p refs Presented at the AIAA Guidance and Control Conf., Danvers, Mass., 11-13 Aug. 1980
(AF Proj. 7600)
(AD-A092613; AFGL-TR-80-0331; AIAA-Paper-80-1754) Avail: NTIS HC A02/MF A01 CSCL 08/5

As missile CEP's get progressively smaller, there is an increasingly urgent requirement to monitor all of the geokinetic effects acting upon the missile launch site, the missile alignment systems, and missile weapons system accuracy. It is therefore necessary to devise a means to monitor the translational rotational changes of the crustal environment around a missile launch area. This must be done to determine the direction, magnitude, frequency, and elasticity of azimuthal movements as they affect missile accuracy. This paper describes a device which was designed, developed and is currently undergoing evaluation at the Air Force Geophysics Laboratory. The device is designed to monitor changes in relative azimuth (translation and rotation) between widely separated points. The test equipment consists of a sending/receiving site; a redirecting mirror site; two reflecting sites; and a modulated laser. GRA

N81-16091# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

OPTIMAL REGULATION WITHIN SPATIAL CONSTRAINTS. AN APPLICATION TO FLEXIBLE STRUCTURES Ph.D. Thesis - MIT

Edward Gregory Taylor Aug. 1980 319 p refs
(AD-A092547; AFIT-CI-80-46D) Avail: NTIS HC A14/MF A01 CSCL 22/2

The contribution of this research is a candidate controller architecture for application to lightly damped, flexible vehicles, where stiffness and mass are distributed parameters. The architecture acknowledges that a reduced order controller is required. Singular perturbation theory and the spatial shaping of control inputs and observation residuals are then coupled to derive an appropriate, asymptotically correct, low frequency plant representation, and a cascaded estimator/optimal regulator is used to construct a linear feedback law based on this low order model. The primary benefit of this approach is the capability to rigorously construct control laws for systems where the dimensions of the control vector, output vector, and the plant dynamics are high. Design examples are given which illustrate that the reduced order designs compare favorably to the optimal fullstate regulator. GRA

N81-16092# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

GUIDANCE AND CONTROL ASPECTS OF TACTICAL AIR-LAUNCHED MISSILES

Oct. 1980 148 p refs Presented at the Guidance and Control Panel Symp., Eglin Air Force Base, Fla., 6-9 May 1980
(AGARD-CP-292; ISBN-92-835-1370-3) Avail: NTIS HC A07/MF A01

Twenty-six papers are presented on the following topics: operational requirements, system considerations, air to surface guided weapons technology, air to air guided weapons technology, and tactical guided weapons evaluation techniques. For individual titles, see N81-16093 through N81-16102.

N81-16093# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Dept.

PRECISION FIRE CONTROL FOR SEMIACTIVE TERMINAL HOMING MISSILES

J. B. Huff and J. L. Baumann *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 13 p (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

The US Army Missile Command's technology base for development of the precision pointing and tracking or fire control for laser guidance is examined. General requirements are transformed into specific design parameters for target acquisition and designation; technology hardware and performance are described. A target designation performance evaluation method, developed out of a specific need to handle large quantities of data, is discussed. A.R.H.

N81-16094# Rockwell International Corp., Columbus, Ohio.

STRAPDOWN SEEKER TECHNOLOGY FOR THE TERMINAL GUIDANCE OF TACTICAL WEAPONS

R. D. Ehrich and P. Vergez (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 15 p refs (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

Strapdown or body fixed seekers with sufficient field of view for the terminal guidance of many tactical weapons are now approaching state of the art. Such seekers have a number of advantages over gimballed seekers, including increased reliability and unlimited line of sight rate capability. The major disadvantage is that inertial line of sight rates are not directly available for the implementation of proportional navigation. To form line of sight rates, the seeker output must be combined with inertial sensor measurements. This, however, results in a potential instability due to seeker gain errors. This problem has been minimized by a dither adaptive parameter identification approach for the measurement and correction of seeker errors. Simulation studies indicate the performance of such systems can be comparable to that of gimballed seekers. The basic principles and problems involved with mechanizing proportional navigation with strapdown seekers are considered and performance results for the dither adaptive technique are presented. Author

N81-16095# Air Force Armament Lab., Eglin AFB, Fla.

INTEGRATION OF DIGITAL AVIONICS COMPONENTS FOR GUIDED WEAPONS

A. M. Henne and D. W. Geyer *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980

8 p Prepared in cooperation with General Dynamics/Convair, San Diego, Calif. (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

The current approach for guided weapon avionics is to use custom digital computational elements connected together with large cables. If these computational tasks can be partitioned into common tasks, and if standard interfaces can be defined, it would promote interchangeable missile guidance and control components and enhance interoperability. The digital integrating subsystem (DIS) program is a current effort to establish these standards and procedures. In the digital integrating subsystem concept, the total data processing requirements of a typical standoff weapon are met by utilizing a number of individual microcomputers that communicate with each other on a serial multiplex bus, the number of microcomputers being dependent upon the total data processing work load of the weapon. Each microcomputer is tasked to do calculations associated with a particular avionics function. Once the computations are completed, the results are 'broadcast' on the multiplex bus. Each computer also listens for only the data it requires on the bus. System design, details on the interface characteristics, and a progress report on the construction of brassboard units are presented. A.R.H.

N81-16096# Lear Siegler, Inc., Grand Rapids, Mich.
INDUSTRY LOW-COST INERTIAL GUIDANCE SYSTEM DEVELOPMENT
Warren K. Stob and Thomas K. Wu (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 22 p refs (For primary document see N81-16092 07-15)
(Contract F08635-79-C-0196)
Avail: NTIS HC A07/MF A01

The necessity for an adverse weather, standoff launch and leave capability in both powered and unpowered guided weapons led to development programs for a low cost inertial guidance subsystem by the United States Air Force. The subsystem, initialized via a prelaunch maneuver sequence to permit transfer alignment and inertial sensor calibration, is used to provide midcourse inertial guidance to a terminal acquisition basket or it can be used with periodic updates provided by other subsystems such as global positioning system, radiometric area correlator, or terrain contour matching for improved accuracy on extended range missions. The history of the low cost inertial guidance system concept development and the design features of the Industry LCIGS configuration are described. Author

N81-16097# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
UNAIDED TACTICAL GUIDANCE FLIGHT TEST
Lawrence D. Perlmutter and C. Keith Fitschen (Air Force Armament Lab., Eglin AFB, Fla.) *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 15 p refs (For primary document see N81-16092 07-15)
(Contract F08637-79-C-0175)
Avail: NTIS HC A07/MF A01

A low cost midcourse guidance technique suitable for standoff tactical weapons uses the launch aircraft navigation system and Kalman filtering to align and calibrate a weapon contained, low cost strapdown navigation system. Post launch, the strapdown system provides unaided inertial guidance along the midcourse trajectory. The strapdown sensor chosen to implement this form of guidance is the low cost inertial guidance subsystem (LCIGS), a modular strapdown package which uses embedded microprocessors, single degree of freedom gyroscopes, and pendulous mass accelerometers. Designed and built for use in tactical weapons, LCIGS features digital torque loops for the gyros and temperature compensation of all six sensors. Studies were conducted to project system performance, and the results indicate that through the alignment and calibration process the predominant LCIGS sensor errors can be reduced by an order of magnitude. A flight test program was structured to demonstrate performance. The unaided tactical guidance concept, the system hardware and software to be tested, the LCIGS and the preflight calibration features incorporated into its support equipment, unique laboratory testing to be performed on the system, and the planned flight tests are described. A.R.H.

N81-16098# Societe Matra (France).
APPLICATION OF MODERN CONTROL THEORY TO THE GUIDANCE OF AN AIR TO AIR DOGFIGHT MISSILE
M. Mirande, M. Lemoine, and E. Dorey *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 12 p In FRENCH; ENGLISH summary (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

An 'optimal' guidance law was derived (taking into account the flight time and the consumed energy in the 'cost' function), without having to assume linearization, i.e., low off boresight conditions with respect to the collision path. A condition on miss distance was set by imposing a constraint on the final state missile to target range. A constant speed missile was assumed which has led to a closed form analytical expression for the guidance law. Because this solution requires knowledge of the final state, an algorithm was developed to mechanize the guidance law. The results obtained with the optimal guidance law were compared to the ones obtained with conventional proportional navigations (true P.N and pure P.N). The results show that the derived optimal guidance law derived is always convergent, even in firing conditions where T.P.N. fails (large off boresight); however, it seems that P.P.N. leads to very comparable results, provided the gain is adequately adjusted, without the complication of needing the final state knowledge. A.R.H.

N81-16099# Raytheon Co., Bedford, Mass. Missile Systems Div.
CLASSICAL VERSUS MODERN HOMING MISSILE GUIDANCE
F. William Nesline and Paul Zarchan *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 17 p refs (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

It is generally accepted that modern guidance systems yield better performance than classical proportional navigation systems. However, it is not always recognized that this better performance carries with it certain costs in improved components or additional instruments. A modern guidance system, MGS, to a classical proportional navigational, PN, homing missile guidance system in terms of performance, robustness, and ease of implementation. Quantitative first order miss distances are compared to show that MGS has the smallest miss if component tolerances can be met, but as component tolerances or measurement errors degrade, MGS degrades faster than PN until, at relatively large component or measurement errors, PN has less miss distance than MGS. A.R.H.

N81-16100# Air Force Armament Lab., Eglin AFB, Fla.
OPTIMAL CONTROL AND ESTIMATION FOR TERMINAL GUIDANCE OF TACTICAL MISSILES
Tom L. Riggs, Jr. *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 11 p refs (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

Good results in developing advanced guidance laws and estimation techniques for application in future tactical weapons were obtained using the linear quadratic, the linear quadratic Gaussian, singular perturbation, reachable set, and f differential game theories. Of the thirty algorithms developed the most simplistic was derived using the linear quadratic Gaussian theory. The derivation of this guidance law is discussed and its performance is compared to proportional navigation. Results show that the use of optimal control and estimation theory can be done without increasing the hardware requirements of the missile system. These concepts also offer the potential for decreasing sensor accuracy specifications without degrading the total system performance. A.R.H.

N81-16101# Boeing Aerospace Co., Seattle, Wash.
DEVELOPMENT TESTING AND FLIGHT CERTIFICATION TESTING OF TERMINALLY GUIDED SUBMISSILES
Jerrel G. Bland, H. Dennis Ulrich, Kenneth L. Wismer, W. Dean Clingman, and Cynthia K. Gronewold *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 15 p (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

The segments of an example terminally guided submissile

(TGSM) tactical mission are examined to identify those guidance and control modes employed in performing the mission. Special control problems resulting from drop testing from helicopter carrier vehicles are also identified to further define the elements of the test problem. Boeing's development test program for TGSM vehicles is then described, including descriptions of our terminal guidance laboratory facilities. Additional detail is given on the laboratory configurations for testing TGSM's using both IR and millimeter wave (MMW) seekers. Development of the real time hardware in the loop (HITL) TGSM simulation is then summarized along with those problems addressed through the use of the HITL simulation. Some HITL simulation data generated during the phase 2 assault breaker program are presented, analyzed, and discussed to show their utilization in evaluating TGSM performance. Author

N81-16102# Air Force Armament Lab., Eglin AFB, Fla.
CLUTTER MODEL VALIDATION FOR MILLIMETER WAVE (MMW) SEEKERS
R. Salemme, D. Bowyer (Systems Control, Inc., Shalimar, Fla.), and R. Merritt (Systems Control, Inc., Shalimar, Fla.) *In* AGARD Guidance and Control Aspects of Tactical Air-launched Missiles Oct. 1980 12 p refs (For primary document see N81-16092 07-15)
Avail: NTIS HC A07/MF A01

In the clutter modeling process, an empirical approach is used in which deterministic map data are used to establish homogeneous terrain subareas. These subareas are then represented, statistically, with a spatial distribution for the median clutter backscatter from each cell and a temporal distribution for the scintillation around this median. In addition, a spatial correlation is applied to the median backscatter for adjacent cells. To validate these clutter models, the primary method is to use the statistics which are derived from measurement data over a variety of different terrain types to verify the statistics in the clutter model. An alternate method is to compare the actual seeker output from flight tests over a specific test site to the output of a simulation of this same test flight. The requirement for validated clutter modes led to the establishment of an extensive clutter measurements program. The requirements for this measurements program were established based on the clutter parameters which must be validated and projected flight configurations of tactical seekers which are currently under development. A.R.H.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N81-16103* National Aeronautics and Space Administration, Washington, D. C.
WET COUNTDOWN DEMONSTRATION AND FLIGHT READINESS FIRING
29 Jan. 1981 14 p refs
(NASA-News-Release-81-19; P81-10019) Avail: NASA Scientific and Technical Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

The prelaunch tests for the Space Transportation System 1 flight are briefly described. Testing is divided into two major sections: the wet countdown demonstration test/flight readiness firing, which includes a 20 second test firing of the orbiter's three main engines, and a mission verification test, which is centered on flight and landing operations. The functions of the countdown sequence are listed and end of mission and mission abort exercises are described. M.G.

N81-16104* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE SPACE SHUTTLE MAIN ENGINE AND THE SOLID ROCKET BOOSTER
14 Oct. 1980 28 p
(P80-10214) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

Development background for the main engine is presented. The engine design and operational characteristics are discussed. A comparison of the Saturn Project engines and the shuttle engines is provided. The recovery sequence for the solid rocket boosters was reviewed. T.M.

N81-16105* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LAUNCH AND POST-FLIGHT ACTIVITIES
1 Dec. 1980 27 p
(P80-10211) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

The activities in the Vehicle Assembly Building are described. The activities for the launch operations including those on the launch pad were reviewed. The recovery of the solid rocket boosters is described. Post-landing operations for the orbiter are discussed. T.M.

N81-16106* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THE SPACE SHUTTLE ORBITER
23 Oct. 1980 59 p
(P80-10217) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, BWI Airport, Md. 21240 CSCL 22B

The wide variety of missions for the shuttle were reviewed. The orbiter structure and design were studied. The subsystems of the space shuttle orbiter are presented and include reaction controls, main propulsion, environmental controls and life support features, electrical packaging, hydraulics and guidance and navigation subsystems. Of special interest was the thermal protection subsystem. T.M.

N81-16107* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ON-BOARD DATA PROCESSING TECHNOLOGY IN THE NEW GENERATION OF PILOTED SPACEFLIGHT
24 Sep. 1980 28 p
(P80-10215) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

The development of the software and data processing system is described. Special emphasis is placed on the onboard computers which are required for the desired autonomous operation of the space shuttle. The fail operational/fail safe system is described in detail. The hardware configurations are also discussed. T.M.

N81-16108* National Aeronautics and Space Administration, Washington, D. C.
TECHNOLOGICAL INNOVATION IN THE DESIGN AND DEVELOPMENT OF THE SPACE TRANSPORTATION SYSTEM
10 Sep. 1980 28 p
(P80-10212) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

A general overview of the system, its intended uses and the reasons for the building of the system are presented. The space shuttle orbiter, the launch and the landing systems of the orbiter and the general applications of the spacecraft are discussed. T.M.

N81-16109*# National Aeronautics and Space Administration, Washington, D. C.
REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL ON THE SPACE SHUTTLE PROGRAM. PART 1: OBSERVATIONS AND CONCLUSIONS Annual Report
Jun. 1976 100 p refs
(NASA-TM-82251) Avail: NTIS HC A05/MF A01 CSCL 22A

Each system was chosen on the basis of its importance with respect to crew safety and mission success. An overview of the systems management is presented. The space shuttle main engine, orbiter thermal protection system, avionics, external tanks and solid rocket boosters were examined. The ground test and ground support equipment programs were studied. Program management was found to have an adequate understanding of the significant ground and flight risks involved. T.M.

N81-16110*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
IMPROVED ATTACHMENT SYSTEM FOR SILICA TILES Patent Application
Robert L. Dotts and Jack W. Holt, inventors (to NASA) (Rockwell International Corp., Downey, Calif.) Filed 17 Dec. 1980 16 p (NASA-Case-MSC-18741-1; US-Patent-Appl-SN-217336) Avail: NTIS HC A02/MF A01 CSCL 22B

The bond strength between a rigid, porous refractory material and a nonrigid substrate is markedly increased by densifying the face of the rigid material opposing the substrate. Densification is accomplished by wetting the refractory material and then impregnating it with a composite slurry having a particle size to fill voids of the porous material. NASA

N81-16111*# National Aeronautics and Space Administration, Washington, D. C.
SPACE TRANSPORTATION SYSTEM AND ASSOCIATED PAYLOADS: GLOSSARY, ACRONYMS, AND ABBREVIATIONS
Jan. 1981 265 p
(NASA-RP-1059) Avail: NTIS HC A12/MF A01 CSCL 22A

A collection of acronyms in everyday use concerning shuttle activities is presented. A glossary of terms pertaining to the Space Transportation System is included. E.D.K.

N81-16112*# National Aeronautics and Space Administration, Washington, D. C.
ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL ON THE SPACE SHUTTLE PROGRAM. PART 1: OBSERVATIONS AND CONCLUSIONS Annual Report
Mar. 1977 63 p
(NASA-TM-82244) Avail: NTIS HC A04/MF A01 CSCL 22A

The panel reviewed the following areas of major significance for the Approach and Landing Test program: mission planning and crew training, flight-readiness of the Carrier Aircraft and the Orbiter, including its flight control and avionics system, facilities, and communications and ground support equipment. The management system for risk assessment was investigated. The Orbital Flight Test Program was also reviewed. Observations and recommendations are presented. T.M.

N81-16113*# National Aeronautics and Space Administration, Washington, D. C.
ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL ON THE SPACE SHUTTLE PROGRAM. PART 2: SUMMARY OF INFORMATION DEVELOPED IN THE PANEL'S FACT-FINDING ACTIVITIES Annual Report
Mar. 1977 232 p refs
(NASA-TM-82245) Avail: NTIS HC A11/MF A01 CSCL 22A

The panel focused its attention on those areas that are considered most significant for flight success and safety. Elements required for the Approach and Landing Test Program, the Orbital Flight Test Program, and those management systems and their implementation which directly affect safety, reliability, and quality control, were investigated. Ground facilities and the training programs for the ground and flight crews were studied. Of special interest was the orbiter thermal protection subsystems. T.M.

N81-16114*# National Aeronautics and Space Administration, Washington, D. C.
ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL ON THE SPACE SHUTTLE PROGRAM. PART 2: SUMMARY OF INFORMATION DEVELOPED IN THE PANEL'S FACT-FINDING ACTIVITIES Annual Report
Jun. 1976 312 p refs
(NASA-TM-82252) Avail: NTIS HC A14/MF A01 CSCL 22A

Safety management areas of concern include the space shuttle main engine, shuttle avionics, orbiter thermal protection system, the external tank program, and the solid rocket booster program. The ground test program and ground support equipment system were reviewed. Systems integration and technical 'conscience' were of major priorities for the investigating teams. T.M.

N81-16115*# National Aeronautics and Space Administration, Washington, D. C.
ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL PART 2: SPACE SHUTTLE PROGRAM. SECTION 1: OBSERVATIONS AND CONCLUSIONS Annual Report
Jun. 1975 37 p refs
(NASA-TM-82248) Avail: NTIS HC A03/MF A01 CSCL 22A

The NASA and contractor management systems, including policies, practices, and procedures for the development of critical systems, subsystems and integration of the program elements, were investigated. The technical development status of critical systems, subsystems, and interfaces is presented. Space shuttle elements were qualified as to potential risks and hazards. The elements included the orbiter, external tanks, main engine, solid rocket boosters, and the ground support facilities. T.M.

N81-16116*# National Aeronautics and Space Administration, Washington, D. C.
ANNUAL REPORT TO THE NASA ADMINISTRATOR BY THE AEROSPACE SAFETY ADVISORY PANEL PART 2: SPACE SHUTTLE PROGRAM. SECTION 2: SUMMARY OF INFORMATION DEVELOPED IN THE PANEL'S FACT-FINDING ACTIVITIES Annual Report
Jun. 1975 284 p refs
(NASA-TM-82249) Avail: NTIS HC A14/MF A01 CSCL 22A

The management areas and the individual elements of the shuttle system were investigated. The basic management or design approach including the most obvious limits or hazards that are significant to crew safety was reviewed. Shuttle program elements that were studied included the orbiter, the space shuttle main engine, the external tank project, solid rocket boosters, and the launch and landing elements. T.M.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N81-16117# Science Applications, Inc., El Segundo, Calif.
SPACECRAFT CHARGING STANDARD REPORT Interim Report
Alan B. Holman 30 Sep. 1980 74 p refs
(Contract F04701-80-C-0009)
(AD-A091953) Avail: NTIS HC A04/MF A01 CSCL 22/2

This report provides an interim version of a Spacecraft Charging Requirements Appendix to MIL-STD-1541. Several key issues remain unresolved at this time. It is extremely difficult to refine this MIL-STD-1541 revision so that it pleases or is at

least acceptable to everyone. SAI has drawn upon a large base of information in developing the MIL-STD-1541 appendix for S/C Charging and SAI has a centralized view of what is needed by the community. This view is inclusive of the interests of SPO/Aerospace, space vehicle contractors and supporting agencies. The technical issues must be resolved among this community and not be biased towards any group. Of prime importance is to ascertain the manner in which the 'worst case' specifications for the environment, charging and discharging should be presented and how to properly incorporate the analysis and test requirements. GRA

N81-16118# Photometrics, Inc., Lexington, Mass.
DATA ANALYSIS OF FILM FROM AFGL ROCKET A31.603 Final Report, 1 Jul. - 30 Sep. 1979
Malcom T. Chamberlain Hanscom AFB, Mass. AFGL 20 Aug. 1979 38 p refs
(Contract F19628-79-M-0010; AF Proj. 7661)
(AD-A092705; PHM-03-79; AFGL-TR-79-0195) Avail: NTIS HC A03/MF A01 CSCL 22/2

The film from the 16 mm camera onboard AFGL spacecraft charging experiment rocket A 31.603 (21 Jan 1978) was reviewed and analyzed to identify coincidence of frames with operation of the rocket's ion and electron accelerators, determine payload aspect and rotation rate, and assess the intensity of fluorescent and other optical radiations from the plasma surrounding the vehicle and the vehicle surface. Upper limits determined for the radiance and volume emission rate of glows excited near the rocket were compared with theoretical predictions. GRA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N81-16119*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACECRAFT TRANSMITTER RELIABILITY
1980 18 p refs Synopsis of Workshop, held in Cleveland, 25-26 Sep. 1979; sponsored by NASA and Air Force
(NASA-CP-2159; E-662) Avail: NTIS HC A06/MF A01 CSCL 17B

A workshop on spacecraft transmitter reliability was held at the NASA Lewis Research Center on September 25 and 26, 1979, to discuss present research and to plan future research areas. Since formal papers were not submitted, this synopsis was derived from audio tapes of the workshop. The following subjects were covered: users' experience with space transmitters; cathodes; power supplies and interfaces; and specifications and quality assurance. A panel discussion ended the workshop. T.M.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N81-16120# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMENTAL INVESTIGATION OF THE DUAL CHAMBER ROCKET MOTOR Final Report
J. F. McFillin, S. T. VanBrocklin, J. E. Beakley, and P. W. Netzer Jul. 1980 56 p refs
(AD-A092135; NPS67-80-006) Avail: NTIS HC A04/MF A01 CSCL 21/8

An experimental investigation was conducted to further determine the operating characteristics of the dual chamber rocket motor. Axisymmetric and two dimensional apparatuses were used with air flow to simulate the actual flow. Without special design considerations the sustainer exhaust was found to always shockdown within the booster cavity except for very short booster lengths. Thrust was found to be insensitive to booster cavity length. With nozzle throat area ratios and booster diameters sized properly supersonic flow could be maintained within the booster cavity. Practical designs for actual motors appear quite feasible, especially for a nozzleless booster. GRA

N81-16121# Ogden Air Logistics Center, Hill AFB, Utah. Propellant Analysis Lab.
QUALIFICATION OF A NEW MAPO SOURCE AND ERL-510 CURING AGENT FOR MINUTEMAN STAGE 1 UF-2121 LINER Annual Report
John A. Thompson Oct. 1980 25 p
(AD-A092678; MAKPH-446(80)) Avail: NTIS HC A02/MF A01 CSCL 13/8

Thiokol Chemical Corporation/Wasatch Division uses MAPO in the production of UF-2121 liner. Thiokol changed MAPO vendors and, therefore, qualification of the new source MAPO was required. Thiokol prepared specimens from the new source and also specimens from the original source which are to be used as the control material in the 10 year surveillance testing program. The specimens were transferred to Ogden ALC for testing and reporting of the data obtained. This report includes the test results for the first, second, third, fourth, fifth, and sixth time testing of the control and special specimens at OOALC. Statistical analysis of the test data showed that the physical properties of the new source compared closely to the old source of UF-2121 liner specimens. In all instances, the mean data for the control and special specimens are well above the minimum requirements found in TWR-7857 Rev A, Thiokol specimen data. Therefore, the capability of the liner from the new source material is expected to perform satisfactorily. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N81-16122# Ames Lab., Iowa.
LOCAL AROMATIC PROPERTIES OF BENZENOID HYDROCARBONS
Milan Randic 1979 10 p refs Presented at Intern. Symp. on Aromaticity, Dubrovnik, Yugoslavia, 3-5 Sep. 1979
(Contract W-7405-eng-82)
(ISM-244; CONF-7909123-1) Avail: NTIS HC A02/MF A01

Individual benzene rings in polycyclic benzenoid hydrocarbons are examined from a graph theoretical position in an effort to characterize structural features responsible for variations in local molecular properties. The basis for the present study is the concept of conjugated circuits. By enumeration of conjugated circuits that encompass individual rings, local diversities in conjugation can be studied quantitatively. The approach defines for each ring in polycyclic conjugated hydrocarbons a code, a sequence of integers which indicate the occurrence of conjugated circuits of size $(4n + 2)$ for a ring. Ring codes thus derived offer an alternative partitioning of the molecular resonance energies. The average ring resonance energy appears to be a good index of the aromatic character for benzenoid systems. The use of the ring codes is further illustrated on a reexamination of ring currents, where regularities in the relative magnitudes, not previously recognized, are indicated. Author

N81-16123*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEW ION EXCHANGE MEMBRANES
Warren H. Philipp, Charles E. May, and Li-Chen Hsu 1980 14 p refs Presented at Fall Meeting of Electrochem. Soc., Hollywood, Fla., 5-10 Oct. 1980
(NASA-TM-81670; E-641) Avail: NTIS HC A02/MF A01 CSCL 07B

A technique for the preparation of ion exchange films composed of radiation crosslinked polyacrylic acid and crosslinked polyacrylate salts is presented. Results suggest that radiolytic crosslinking occurs at the alpha carbon on polyacrylic acid via

hydrogen abstraction by hydrogen atoms produced by the radiolytic decomposition of water. Conditions of reaction media and radiation dose are discussed for optimum crosslinking. Practical use of crosslinked polyacrylate ion exchange films for the removal of metal cations from dilute solution was demonstrated on a laboratory scale. The wet strength of membranes comprising various polyacrylate salts is correlated with water content of the swelled membrane. J.M.S.

N81-16124# Oklahoma Univ., Norman. Dept. of Chemistry.
SYSTEMS FOR THE STORAGE OF MOLECULAR OXYGEN: A STUDY Final Technical Report, 1980
Harmon B. Abrahamson 25 Nov. 1980 42 p refs
(Contract N00014-79-C-0717; NR Proj. 053-727)
(AD-A092794) Avail: NTIS HC A03/MF A01 CSCL 07/1

A search of the current chemical literature has been performed in an effort to identify systems to generate and store molecular oxygen. Most of the current oxygen production capacity is based on the cryogenic fractionation of air; alternatives for smaller scale or more mobile situations were sought. Systems were classified according to one of four types: adsorption/adsorption, chemical reaction, formation from cheap substrate, and continuous separation. At present, only zeolite-based adsorption systems are commercially competitive; three other candidate systems for further development are identified. GRA

N81-16125# Texas A&M Univ., College Station. Dept. of Chemistry.
RATE ACCELERATING POLYMERIC COFACTORS IN THE HOMOGENEOUS HYDROGENATION OF ALKENES Interim Technical Report
D. E. Bergbreiter and M. S. Bursten 1 Nov. 1980 20 p refs Submitted for publication
(Contract N00014-77-C-0426)
(AD-A092162; TR-6) Avail: NTIS HC A02/MF A01 CSCL 07/3

The novel use of polymeric reagents as selective phosphine absorbers in a homogeneous catalysis is presented. Silver(1) p-toluene sulfonate (A) is shown to absorb tertiary phosphines from organic solution and to restore PPh3-inhibited homogeneous hydrogenation of alkenes by RhCIL3 (L-PPh3) to a non-inhibited rate. Treatment of RhCIL3 with ethylene in presence of A followed by addition of a second alkene and removal of ethylene under reduced pressure leads to an increased rate of hydrogenation for several alkenes. GRA

N81-16126# California Univ., Berkeley. Lawrence Berkeley Lab.
PROPERTIES OF NUCLEI AT VERY HIGH SPIN
F. S. Stephens Sep. 1980 16 p refs Presented at the Intern. Conf. on Nucl. Phys., Berkeley, Calif., 24-30 Aug. 1980
(Contract W-7405-eng-48)
(LBL-11620; CONF-800863-7) Avail: NTIS HC A02/MF A01

The structure of high spin states is discussed in relation to methods of investigation. Nuclear structure at very high spins involves an interplay between collective (often rotational) and noncollective (individual particle alignment) behavior. Techniques for studying gamma ray energy correlations promise to give detailed information about both of these aspects of nuclear behavior up to the very highest spins that can be populated. M.G.

24 COMPOSITE MATERIALS

Includes laminates.

N81-16127*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ABSORBENT PRODUCT AND ARTICLES MADE THEREFROM Patent Application
James V. Correale and Frederic S. Dawn, inventors (to NASA) Filed 24 Dec. 1980 14 p
(NASA-Case-MSC-18223-1; US-Patent-Appl-SN-219681) Avail: NTIS HC A02/MF A01 CSCL 11G

A multilayer absorbent product is described for use in contact with the skin to absorb fluids, the product having a water pervious facing layer for contacting the skin, a first fibrous wicking layer overlaying the water pervious layer, a first container section defined by inner and outer layers of a water pervious wicking material between which is disposed a first absorbent mass, a second container section defined by inner and outer layers of a water pervious wicking material between what is disposed a second absorbent mass and a liquid impermeable/gas permeable layer overlaying the second fibrous wicking layer. NASA

N81-16128*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARTIAL INTERLAMINAR SEPARATION SYSTEM FOR COMPOSITES Patent Application
Wolf Elber, inventor (to NASA) Filed 7 Feb. 1980 12 p
(NASA-Case-LAR-12065-2; US-Patent-Appl-SN-119337) Avail: NTIS HC A02/MF A01 CSCL 11D

An interlaminar separation system for composites is described wherein a thin layer of a perforated foil film is interposed between adjacent laminae of a composite formed from prepreg tapes to thereby permit laminae adherence through the perforations and produce a composite structure having improved physical property characteristics. NASA

N81-16129*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TESTS OF GRAPHITE/POLYIMIDE SANDWICH PANELS IN UNIAXIAL EDGEWISE COMPRESSION
Charles J. Camarda Dec. 1980 79 p refs
(NASA-TP-1785; L-13998) Avail: NTIS HC A05/MF A01 CSCL 11D

The local and general buckling behavior of graphite/polyimide sandwich panels simply supported along all four edges and loaded in uniaxial edgewise compression were investigated. Material properties of sandwich panel constituents (adhesive and facings) were determined from flatwise tension and sandwich beam flexure tests. Buckling specimens were 30.5 by 33 cm, had quasi-isotropic, symmetric facings, and a glass/polyimide honeycomb core. Core thicknesses were varied and three panels of each thickness were tested at room temperature to investigate failure modes and corresponding buckling loads. Specimens 0.635 cm thick failed by overall buckling at loads close to the analytically predicted buckling load; all other panels failed by face wrinkling. Results of the wrinkling tests indicated that several buckling formulas were unconservative and therefore not suitable for design purposes; a recommended wrinkling equation is presented.R.C.T.

N81-16130*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MECHANICAL PROPERTY CHARACTERIZATION OF BORSIC/ALUMINUM LAMINATES AT ROOM AND ELEVATED TEMPERATURES
Robert R. McWithey and Dick M. Royster Dec. 1980 65 p refs
(NASA-TP-1761; L-13763) Avail: NTIS HC A04/MF A01 CSCL 11D

Six Borsic/aluminum laminate orientations exposed to a braze temperature cycle were tested in tension, compression, and shear to determine tangent modulus, maximum stress and strain, and Poisson's ratio of the laminates at room and elevated temperatures. Mechanical properties in tension were determined from flat tensile and sandwich beam tests. Room temperature flat tensile tests were performed on laminates in the as-received condition to compare with specimens exposed to a braze temperature cycle. Sandwich beam tests were also used to determine mechanical properties in compression. Shear properties were determined from biaxially loaded, picture frame shear specimens. Results are presented by using functional relations between stress and strain and tangent modulus and strain, and in tables by indicating maximum stress and strain and Poisson's ratio. R.C.T.

N81-16131*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
DETERMINATION OF PRINCIPAL STRESS IN BIREFRINGENT COMPOSITES BY HOLE-DRILLING METHOD
R. Prabhakaran [1981] 18 p refs Presented at 36th Ann. Conf. of the Soc. of the Plastics Ind. (SPI) of Reinforced Plastics/Composites Inst., Washington, D.C., 16-20 Feb. 1981

(NASA-CR-163867) Avail: NTIS HC A02/MF A01 CSCL 11D

The application of transmission photoelasticity to stress analysis of composite materials is discussed.The method consists in drilling very small holes at points where the state of stress has to be determined. Experiments are described which verify the theoretical predicitons. The limitations of the method are discussed and it is concluded that valuable information concerning the state of stress in a composite model can be obtained through the suggested method. J.M.S.

N81-16132*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PREDICTION OF COMPOSITE THERMAL BEHAVIOR MADE SIMPLE

Christos C. Chamis 1981 33 p refs Presented at the 36th Ann. Conf. of the Soc. of the Plastics Ind. (SPI) Reinforced Plastics/Composites Inst., Washington, D.C., 16-20 Feb. 1981 (NASA-TM-81618; E-624) Avail: NTIS HC A03/MF A01 CSCL 11D

A convenient procedure is described to determine the thermal behavior (thermal expansion coefficients and thermal stresses) of angleplied fiber composites using a pocket calculator. The procedure consists of equations and appropriate graphs for various (+ or - theta) ply combinations. These graphs present reduced stiffness and thermal expansion coefficients as functions of (+ or - theta) in order to simplify and expedite the use of the equations. The procedure is applicable to all types of balanced, symmetric fiber composites including interply and intraply hybrids. The versatility and generality of the procedure is illustrated using several step-by-step numerical examples. Author

N81-16133*# Pennsylvania State Univ., University Park.

STUDY AND MODIFICATION OF THE REACTIVITY OF CARBON FIBERS Final Report

P. L. Walker, Jr., I. M. Ismail, O. P. Mahajan, and T. A. Eapen 1 Feb. 1980 20 p refs Prepared for JPL

(Contract NAS7-100; JPL-955236)

(NASA-CR-163883; FR-1; JPL-9550-462) Avail: NTIS HC A02/MF A01 CSCL 11D

The reactivity to air of polyactylonitrile-based carbon fiber cloth was enhanced by the addition of metals to the cloth. The cloth was oxidized in 54 wt% nitric acid in order to increase the surface area of the cloth and to add carbonyl groups to the surface. Metal addition was then achieved by soaking the cloth in metal acetate solution to effect exchange between the metal carbon and hydrogen on the carbonyl groups. The addition of potassium, sodium, calcium and barium enhanced fiber cloth reactivity to air at 573 K. Extended studies using potassium addition showed that success in enhancing fiber cloth reactivity to air depends on: extent of cloth oxidation in nitric acid, time of exchange in potassium acetate solution and the thoroughness of removing metal acetate from the fiber pore structure following exchange. Cloth reactivity increases essentially linearly with increase in potassium addition via exchange. A.R.H.

N81-16134*# Martin Marietta Corp., Denver, Colo.

NONMETALLIC MATERIALS CONTAMINATION STUDIES Final Technical Report, 2 Apr. 1979 - 14 Nov. 1980

J. A. Muscari and G. Beverlin 16 Dec. 1980 187 p refs Prepared for JPL

(Contracts NAS7-100; JPL-955426)

(NASA-CR-163890; JPL-9950-470; MCR-80-637) Avail: NTIS HC A09/MF A01 CSCL 11D

In order to impose adequate contamination control requirements in the selection of Wide Field Planetary Camera (WFPC) materials and to develop a data base of potential optical degradation of the WFPC charge-couple device window, the outgassing properties of WFPC materials and the collected volatile condensed material (CVCM) effects on MgF2 transmittance were measured. Changes in the transmittance were monitored in the wavelength region from 115 nm to 300 nm for selected CVCM thicknesses up to 150 nm. The outgassing properties of reemitted CVCM were also studied. M.G.

N81-16135*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MECHANISMS OF FATIGUE DAMAGE IN BORON/ALUMINUM COMPOSITES

W. S. Johnson Dec. 1980 55 p refs Presented at the ASTM Symp. on Damage in Composite Mater.: Basic Mech. Accumulation, Tolerance, and Characterization, Bal Harbour, Fla., 10-14 Nov. 1980

(NASA-TM-81926) Avail: NTIS HC A04/MF A01 CSCL 11D

Tensile fatigue tests were conducted on several laminates of boron/aluminum (6061-0). In laminates with 0 deg fibers on the outside, an analysis that identifies 'shakedown' conditions predicted the stress amplitude below which no fatigue damage accumulated. A fatigue damage accumulation model which relates matrix fatigue cracking and the overall laminate properties is described. A model for the saturation damage stage development is presented, that identical laminates, tested in directions 90 deg apart (such that one layup has 90 deg outer plies and the other 0 deg), have different fatigue behaviors due to the stacking sequence. The 90 deg plies on the surface develop cracks earlier than predicted by shakedown. An attempt was made to explain this stacking sequence effect. Variable load history effects on the fatigue damage response were investigated. Tests reveal that for a given stress ratio the specimen seeks the saturation damage state for the largest stress range to which it is subjected. It was also found that little damage is generated by shifting a given stress range down, whereas significant damage may be created by shifting it upward. The laminate stresses were always tensile. A.R.H.

N81-16136*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STRAIN RATE, TEMPERATURE, AND HUMIDITY ON STRENGTH AND MODULI OF A GRAPHITE/EPOXY COMPOSITE

J. M. Lifshitz Jan. 1981 26 p refs

(NASA-TM-81247; A-8381) Avail: NTIS HC A03/MF A01 CSCL 11D

Results of an experimental study of the influence of strain rate, temperature and humidity on the mechanical behavior of a graphite/epoxy fiber composite are presented. Three principal strengths (longitudinal, transverse and shear) and four basic moduli (E1, E2, G12 and U12) of a unidirectional graphite/epoxy composite were followed as a function of strain rate, temperature and humidity. Each test was performed at a constant tensile strain rate in an environmental chamber providing simultaneous temperature and humidity control. Prior to testing, specimens were given a moisture preconditioning treatment at 60 C. Values for the matrix dominated moduli and strength were significantly influenced by both environmental and rate parameters, whereas the fiber dominated moduli were not. However, the longitudinal strength was significantly influenced by temperature and moisture content. A qualitative explanation for these observations is presented. Author

N81-16137*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LARGE-SCALE CARBON FIBER TESTS

Richard A. Pride Dec. 1980 104 p refs

(NASA-TM-80218) Avail: NTIS HC A06/MF A01 CSCL 11D

A realistic release of carbon fibers was established by burning a minimum of 45 kg of carbon fiber composite aircraft structural components in each of five large scale, outdoor aviation jet fuel fire tests. This release was quantified by several independent assessments with various instruments developed specifically for these tests. The most likely values for the mass of single carbon fibers released ranged from 0.2 percent of the initial mass of carbon fiber for the source tests (zero wind velocity) to a maximum of 0.6 percent of the initial carbon fiber mass for dissemination tests (5 to 6 m/s wind velocity). Mean fiber lengths for fibers greater than 1 mm in length ranged from 2.5 to 3.5 mm. Mean diameters ranged from 3.6 to 5.3 micrometers which was indicative of significant oxidation. Footprints of downwind dissemination of the fire released fibers were measured to 19.1 km from the fire. E.D.K.

N81-16138*# Howard Univ., Washington, D. C. Dept. of Mechanical Engineering.

EFFECT OF LOAD INTRODUCTION ON GRAPHITE EPOXY

COMPRESSION SPECIMENS Final Report
Robert Reiss and Tse-Min Yao Jan. 1981 103 p refs
(Grant NAG1-23)
(NASA-CR-163919) Avail: NTIS HC A06/MF A01 CSCL 11D

Compression testing of modern composite materials is affected by the manner in which the compressive load is introduced. Two such effects are investigated: (1) the constrained edge effect which prevents transverse expansion and is common to all compression testing in which the specimen is gripped in the fixture; and (2) nonuniform gripping which induces bending into the specimen. An analytical model capable of quantifying these foregoing effects was developed which is based upon the principle of minimum complementary energy. For pure compression, the stresses are approximated by Fourier series. For pure bending, the stresses are approximated by Legendre polynomials. E.D.K.

N81-16139*# Boeing Commercial Airplane Co., Seattle, Wash. Advanced Structural Concepts Organization.
ENVIRONMENTAL EXPOSURE EFFECTS ON COMPOSITE MATERIALS FOR COMMERCIAL AIRCRAFT Quarterly Technical Progress Report, 1 Nov. 1979 - 30 Aug. 1980
Daniel J. Hoffman Aug. 1980 56 p refs
(Contract NAS1-15148)
(NASA-CR-165649; D6-44815-9; QTPR-9) Avail: NTIS HC A04/MF A01 CSCL 11D

The test program concentrates on three major areas: flight exposure; ground based exposure; and accelerated environmental effects and data correlation. Among the parameters investigated were: geographic location, flight profiles, solar heating effects, ultraviolet degradation, retrieval times, and test temperatures. Data from the tests can be used to effectively plan the cost of production and viable alternatives in materials selection. T.M.

N81-16140# Oklahoma Univ., Norman. School of Aerospace Mechanical and Nuclear Engineering.
COMPOSITE MATERIALS: A SURVEY OF THE DAMPING CAPACITY OF FIBER-REINFORCED COMPOSITES
Charles W. Bert Aug. 1980 14 p refs Presented at Symp. on Damping Appl. for Vibration Control, Chicago, Nov. 1980; sponsored by the Appl. Mech. Div.
(Contract N00014-78-C-0647; NR Proj. 064-609)
(AD-A092194; OU-AMNE-80-17; TR-18) Avail: NTIS HC A02/MF A01 CSCL 11/4

A discussion is given on the importance of damping in fiber reinforced composites and is followed by concise definitions of the various measures of damping. The current state of the theory of damping in fiber reinforced composites is reviewed for perfectly bonded viscoelastic composites, yielding matrix composites, and those in which slip takes place at the fiber matrix interface. General trends in stiffness and damping of composites with polymeric matrices are reviewed. GRA

N81-16141# Sandia Labs., Albuquerque, N. Mex.
THERMOMECHANICAL CHARACTERIZATION OF GRAPHITE/POLYIMIDE COMPOSITES
Stephanie C. Kunz 1980 38 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-1060C; CONF-801148-3) Avail: NTIS HC A03/MF A01

The stiffness, strength and shear properties of three polyimide resins (NR-150b2, PMR-15 and CPI-2237) combined with three different moduli graphite fibers (C-6000, F-5A and Gy-70) were determined in the temperature range 68 Cf (20 C) to 700 F (371 C). Flexural test results from the various unidirectional composites showed that stiffness retention with increasing temperature is affected only by the thermal integrity of the polyimide matrix. No loss in modulus occured up to 600 F (316 C) for the PMR-15 and cPI-2237 based composites (Tsub g = 710 F (377 C)) or to 500 F (260 C) for the NR-150B2 based material (T sub g = 660 F (349 C)), with any of the three fibers. In contrast, both flexure and shear strengths showed fiber dependent behavior, irrespective of the matrix resin, with increasing temperature. Strength retention appears directly related to degree of graphitization (modulus) of the fibers. The accumulated mechanical property data, some previously unknown, are correlated with microstructural features such as the fiber-matrix adhesion, porosity and processing defects. This study of a family of graphite/polyimide composites provides a basis for selecting a high temperature, structural weight-saving material. T.M.

N81-16142# Massachusetts Inst. of Tech., Cambridge. Marine Industry Advisory Services.
NONDESTRUCTIVE EVALUATION OF FIBER COMPOSITES
John B. Bidwell 7 Jul. 1980 26 p refs
(PB81-108144; MITSG-80-8; OPPORTUNITY-BRIEF-21; NOAA-80091504) Avail: NTIS HC A03/MF A01 CSCL 11D

A nondestructive, thermal testing technique was developed to detect flaws in fiberglass composites such as hulls of small marine craft. The technique involves uniform application of heat to one side of a composite structure that has been coated with a cholesteric liquid crystal compound. The temperature rise causes the liquid crystal to change color. Anomalies in the pattern of surface temperature, indicative of various kinds of internal flows, show up as anomalies in the pattern of color change in the liquid crystal coating. GRA

N81-16143*# New Mexico Univ., Albuquerque. Technology Application Center.
ABLATION AND ABLATIVE MATERIALS. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Jul. 1980
Samuel C. Mauk Sep. 1980 70 p Supersedes NTIS/PS-79/0833 Sponsored by NASA and NTIS
(NASA-CR-163915; PB80-815855; NTIS/PS-79/0833/8) Avail: NTIS HC $30.00/MF $30.00 CSCL 11G

These citations from the international literature concern various aspects of ablation and ablative materials. Included are articles covering aerodynamic heating, heat shielding, radiative heat transfer, atmospheric entry, reentry effects, reentry shielding and reentry vehicles. Ablation of meteorites is also covered. Articles concerning various ablative materials are included. GRA

N81-16144# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ELECTROMAGNETIC EFFECTS OF (CARBON) COMPOSITE MATERIALS UPON AVIONICS SYSTEMS
F. S. Stringer, (ed.) (RAE, Farnborough, England) Oct. 1980 369 p refs Partly in ENGLISH and FRENCH Conf. held at 39th Tech. Meeting of the Avionics Panel of AGARD, Lisbon, 16-19 Jun. 1980.
(AGARD-CP-283; ISBN-92-835-0277-9) Avail: NTIS HC A16/MF A01

The impact of electromagnetic effects generated by the introduction of composite materials in aircraft engineering is discussed. Topics include materials and applications, characteristics, measurements, modelling and standards, electromagnetic effects on radiation patterns, lightning problems, protection, and tradeoff methods. For individual titles, see N81-16145 through N81-16166.

N81-16145*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CURRENT AND PROJECTED USE OF CARBON COMPOSITES IN UNITED STATES AIRCRAFT
Robert Leonard and Daniel R. Mulville (Naval Air Systems Command, Washington, D.C.) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 19 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01 CSCL 11D

Carbon composite materials are finding limited use in both civil and military aircraft structures to exploit their weight saving potential for improved performance or fuel efficiency. Since these needs are growing, and a manufacturing cost savings potential is also recognized, wider use of composites in the near future may be expected. Carbon composites generally involve fiber volume fractions in excess of 60 percent in a variety of orthotropic sandwich or solid laminates. Bidirectional woven carbon cloth, common in recently designed structure, may provide higher, more uniform laminate conductivities than tape. E.D.K.

N81-16146# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE EFFECT OF THE IN-SERVICE ENVIRONMENT ON COMPOSITE MATERIALS (RESUME OF THE APRIL

1980 ATHENS CONFERENCE) [EFFET DE L'ENVIRONMENT EN SERVICE SUR LES MATERIAUX COMPOSITES (RESUME DUE CONGRES D'ATHENES-AVRIL 80)]
George Jube *In its* Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 4 p In FRENCH (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Reported experience of the effect of physical and mechanical aggressions (environment) on composite materials and structures is summarized. Topics covered include: (1) the physical chemistry of the environment and the sensitivity of the composite materials to humidity; (2) the behavior of composite materials in spatial ambience, particularly in vacuum; (3) rules for predicting damage to composite structures and the effect of accidental impact; (4) atmospheric physical phenomena, particularly lightning and rain erosion; and (5) the in service behavior of helicopter blades, NASA experience with transport aircraft structures, and USAF and Navy experience with boron and carbon fiber composites.
Transl. by A.R.H.

N81-16147# British Aerospace Aircraft Group, Preston (England).
APPLICATION OF CARBON FIBRE COMPOSITES TO MILITARY AIRCRAFT STRUCTURES
T. Sharples *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 17 p (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The high specific strength of CFC offers weight saving potential to the aircraft structural engineers. Design and manufacturing studies have shown that this potential can be realized and that a maximum utilization, where 40 percent of the aircraft structure is made from CFC, mass savings of about 12 percent can be expected. These savings can be increased to as much as 20 percent if the aircraft is resized for constant performance. Cost studies indicate that, if full advantage is taken of automated techniques and the weight reductions structures containing CFC should cost less than for the metal equivalents. Work is continuing to assess the EMC problems in order to ensure that full advantage can be taken of these potential weight and cost savings on future military aircraft.
E.D.K.

N81-16148# Boeing Aerospace Co., Seattle, Wash.
ELECTROMAGNETIC SHIELDING CHARACTERISTICS OF ADVANCED COMPOSITES
David F. Strawe *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 15 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

A considerable body of data was gathered on the basic electromagnetic (EM) properties of graphite advanced composite materials. A sampling of that data relevant to the EM shielding applications is presented. A basic set of shielding parameters is introduced which describes the intrinsic shielding characteristics of composite materials, enhanced conductivity coatings, and electrical joints in those materials and coatings. Measurement concepts for these parameters are discussed which were used over the frequency range 0 to 18 GHz. Cross axis layups of graphite composites exhibit a uniform conductivity isotropic in the plane of the graphite filaments. This planar conductivity normally falls in the range of 10,000 to 20,000 mhos/meter. The third axis conductivity component, generally unimportant in shielding applications, is commonly an order of magnitude or more smaller. These composites can provide useful shielding from EM environments if they are electrically bonded in a continuous manner to the rest of the structure. Common mechanical joints between composite sections are highly resistive and unreliable electrical joints. Joining concepts which provide good electrical connections over wide frequency ranges were developed and are described.
E.D.K.

N81-16149# GEC-Marconi Electronics Ltd., Chelmsford (England).
THEORETICAL CALCULATION OF RF PROPERTIES OF CARBON FIBRE LAMINATES
D. C. Brewster *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 16 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The purpose of the work presented was to find a mathematical theory to describe the electromagnetic behavior of material consisting of a sequence of carbon fiber composite laminae. The analysis applies to approximately planar regions which are not near joints, bonds, or other electrical discontinuities. The model adopted is an infinite sheet and each carbon fiber lamina is modelled as a homogeneous anisotropic conducting lamina. Some theoretical justification for this is given. An alternative theory based on replacing the entire sheet by a single homogeneous layer was also considered and its range of validity investigated. The conductivities used were obtained experimentally from unidirectional samples by other researchers. The shielding was calculated of a plane wave normally incident on the infinite sheet and also the reflected field. The shielding improvement was calculated for a thin aluminu. coating. The variation of apparent resistivity with frequency was investigated. It is shown that as regards shielding and reflection the infinite sheet can be characterized by surface and transfer impedances. These quantities can be used to calculate electromagnetic field shielding of finite objects. Some calculations are given of shielding by a plane screen when illuminated by an electromagnetic pulse.
E.D.K.

N81-16150# ERA Ltd., Leatherhead (England).
RF RESISTIVITY AND SCREENING CHARACTERISTICS OF CFC MATERIALS
D. A. Bull, G. A. Jackson, and B. W. Smithers *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 21 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

A series of investigations were made to determine both the electrical resistance characteristics of carbon fiber composite (CFC) samples and their screening properties. Resistivity was examined from dc to 300 MHz and certain effects of environment were noted under dc test conditions. The measurement of screening properties required much larger samples and test frequencies ranged from 150 KHz to 30 MHz for the magnetic mode and from 50 MHz to 1000 MHz for the electric mode. The methods and techniques employed are described with brief comments on some of the theoretical aspects of conduction and screening.
E.D.K.

N81-16151# Rochester Inst. of Tech., N. Y. Dept. of Electrical Engineering.
THE MEASUREMENT OF ELECTRICAL CONDUCTIVITY IN CARBON/EPOXY COMPOSITE MATERIALS OVER THE FREQUENCY RANGE OF 75 MHZ TO 2.0 GHZ
W. F. Walker *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 15 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

A stripline technique for the measurement of longitudinal and transverse conductivity of graphite (carbon)/epoxy composite materials over the VHF/UHF (75 MHz to 2.0 GHz range) is described. The method is unusual in that it is essentially free of the uncertain effects of contact resistance between the sample and the measurement apparatus. The underlying theory of the method rests on the relationship between the conductivity of the sample and the lossy standing wave patterns established on the strip transmission line. The essentials of this theory are presented. In addition to the presentation of the theory behind the method, the paper includes illustrations of experimental models of the test transmission line. Longitudinal and transverse conductivity measurements on graphite/epoxy are also presented as well as longitudinal measurements of boron/epoxy and aluminum in the 1.0 GHz to 2.0 GHz range.
E.D.K.

N81-16152# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
EMC, LIGHTNING AND NEMP-PROTECTION-NEW REQUIREMENTS FOR APPROVED SPECIFICATIONS WHEN USING CFRP
D. Jaeger and K. H. Rippl *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 18 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The use of carbon fiber reinforced plastics (CFRP) in modern

aircraft achieves good advantages for mechanical strength and is weightsaving, compared with aluminum structures. In spite of the advantages there are disadvantages in using CFRP materials. These are mainly unwanted electromagnetic effects on electronic equipment, caused by electromagnetic interference lightning, electrostatic discharges, and nuclear electromagnetic pulse (NEMP). The reason for these problems is lower shielding effectiveness of the aircraft structure as compared to aluminum. Specifications used for aircraft today do not pay regard to the requirements of these materials. Proposals are made as to how the specifications should be modified. E.D.K.

N81-16153# Allen Clark Research Centre, Towcester (England).
THE ELECTRICAL EFFECTS OF JOINTS AND BONDS IN CARBON FIBER COMPOSITES
J. Brettle, K. J. Lodge, and R. Poole (Plessey Electronic Systems Research, Havant, England) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 17 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The types of joint investigated include dry compression joints, bolted joints, and adhesively bonded structures. Their electrical properties were evaluated from dc up to 50 MHz, as well as certain specific higher frequencies. A variety of pretreatments and assembly methods were investigated. All the joints as initially produced to current aircraft practice had too high an impedance for the electrical requirements of an airframe. Various methods of reducing the joint impedance were proposed and subjected to electrical and environmental tests. It is now possible to produce electrically invisible bolted joints and adhesive joints with much improved conductivity. It was found possible to permanently alter the joint impedance by the passage of a current through the joint. This effect was investigated and a possible mechanism of this effect suggested. The investigation of the possible production of radio frequency intermodulation products at joints were carried out, but few intermodulation products were found from any of the joints examined other than butt joints made with exposed carbon fibers in the joint. E.D.K.

N81-16154# Royal Aircraft Establishment, Farnborough (England).
THE UK MINISTRY OF DEFENCE PROGRAMME ON THE ELECTROMAGNETIC PROPERTIES OF CARBON FIBER COMPOSITES
J. M. Thomson and R. H. Evans *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 9 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

With some exceptions, work on the electrical properties of carbon fiber composites (CFV) is regarded as part of an overall program on electromagnetic effects (EMC, EMP, lightning, etc.). The relationship of the CFC work to the remainder of the program is discussed, and the principal investigations outlined and reviewed. One particular package, shielding measurements on a cockpit section is described in detail. It is shown that the major areas of concern are the bonding and jointing of the material and its characteristics at HF and below. This latter topic has an impact on shielding (including EMP and lightning sources) and aerial installation. Finally, the use which is to be made of the information from these programs is discussed. E.D.K.

N81-16155# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
A FRENCH FLIGHT TEST PROGRAM ON THE ELECTROMAGNETIC EFFECTS OF LIGHTNING [PROGRAMME FRANCAIS D'ESSAIS EN VOL SUR LES EFFETS ELECTROMAGNETIQUES DE LA FOUDRE]
J. C. Alliot and D. Gall (Centre d'Essasis Aeronautiques, Toulouse) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 9 p refs In FRENCH (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Under the aegis of the French Aeronautical Technical Service, a flight test program for evaluating electromagnetic perturbations of lightning has been operating since 1978. This test program, conducted by CEAT, CEV, and ONERA, uses an Air Force TRANSALL C160 carrying instrumentation for detecting phenomena associated with direct or near lightning strikes. These include the current of the lightning (impulsive and continuous components) the current on the skin of different parts of the structure; the internal and external electromagnetic fields; and the overvoltages on diverse equipment and circuits on board. Various sensors allow characterization of the electric state of the aircraft at the time of the lightning strikes (equilibrium potential, current of the charge of the triboelectric origin, external atmospheric electric field). The behavior of panel structures made of composite materials are studied with regard to electromagnetic radiation in order to define protection systems. Following diverse modifications and additions to the instrumentation used in tests since 1978, a new experimental program begins in 1980.
Transl. by A.R.H.

N81-16156# Westland Helicopters Ltd., Yeovil (England).
AIRCRAFT MANUFACTURERS APPROACH TO THE E.M.C./AVIONICS PROBLEMS ASSOCIATED WITH THE USE OF COMPOSITE MATERIALS
G. Barton and I. P. MacDiarmid (British Aerospace, Warton, England) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 23 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Detailed examples are given of the approach taken by the U.K. aircraft manufacturers to the EMC/avionic problems associated with the use of carbon fiber composites (CFC). Examples of structures that required flight clearance within relatively short timescales are discussed. These are the fitting of CFC panels to Jaguar and lightning strike investigations on composite demonstrator rotor blades. The work undertaken to address the long term problems of composite aircraft and their effects on avionic systems is outlined. This includes CFC fuselage investigations, conductivity measurements, and an Earth return study. E.D.K.

N81-16157# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
CONDUCTIVITY MODIFICATION OF BORON FIBERS
Richard Y. Kwor and Carlos Alberto PazdeAraujo *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 17 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Boron fibers have high specific strength and specific modulus, and are widely used in advanced composite materials. Its weakness lies in the low dc conductivity. Two possible ways of increasing the fiber conductivity to alleviate electromagnetic effects are investigated. The first is the doping of boron fiber using high temperature carbon diffusion. It is found that if the temperature is kept low enough not to deteriorate the mechanical properties of the fiber then there is no conductivity enhancement even after 24 hours of heat treatment. The second method is to electroplate the boron fibers with Ni. Plated near room temperature, the Ni forms a thin sheath around the boron fiber which retains its superior mechanical properties. The electrical property of the plated fiber is characterized and the effect of high temperature on the Ni-B system is investigated using a scanning electron microscope. Author

N81-16158# Centre d'Essai Aeronautique, Toulouse (France).
TENSION INDUCED IN THE CABLES INSIDE CLOSED METAL STRUCTURES AND IN CARBON EPOXY SUBMITTED TO A LIGHTNING-TYPE IMPULSE CURRENT [TENSION INDUITE DANS LES CABLES A L'INTERIEUR DE STRUCTURES FERMEES METALLIQUES ET EN CARBONE EPOXY SOUMISES A UNE IMPULSION DE COURANT TYPE FOUDRE]
Denis Gall *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 11 p In FRENCH (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Results are presented of theoretical and experimental studies on the mechanics of the induction of overvoltages in electric cables located in the interior of closed structures when they are surrounded by an impulse current of the lightning type. The contribution of two parameters, the diffusion of current on the skin and the internal magnetic field, is considered and compared

for a structure made of an aluminum alloy and one made of carbon fibers. Transl. by A.R.H.

N81-16159# McDonnell Aircraft Co., St. Louis, Mo.
ELECTROMAGNETIC INTEGRATION OF COMPOSITE STRUCTURE IN AIRCRAFT
G. L. Weinstock *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 16 p (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Certain U.S. Navy and Marine Corps aircraft are being designed and produced which have significant portions of the skin and substructure fabricated from graphite/epoxy composite material. The F-18 Hornet has approximately 50% of its surface area composite and the AV-8B V/STOL utilizes composite material for its wing, tail, and forward fuselage. Extensive analysis and testing was performed during the last seven years to define those parameters necessary for successful electromagnetic integration of graphite/epoxy composite into these aircraft. Descriptions of the tests, analyses, and design processes including procedures, methods, results, and design improvements are presented in this paper. The specific investigations addressed are: (1) basic material properties; (2) inherent electromagnetic shielding; (3) intermodulation effects; (4) effects on antennas; (5) panel shielding; (6) joint effects and improvements; (7) joint impedance; (8) access door design and improvements; (9) bonding; (10) large fuselage section shielding; and (11) complete wing shielding. The above tests and supporting analyses were performed on different types of composite construction, thickness, and size and were usually related to comparable aluminum articles. Some of the variations assessed and described in the paper are aluminum honeycomb, syntactic core and monolithic materials, combinations of lap and shear joints, and selected metallic coatings. E.D.K.

N81-16160# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FLIGHT TESTS FOR STUDYING RADIOELECTRIC PERTURBATIONS OF AN ELECTROSTATIC ORIGIN [ESSAIS EN VOL POUR L'ETUDE DES PERTURBATIONS RADIOELECTRIQUES D'ORIGINE ELECTROSTATIQUE]
P. Laroche, R. Weber (Societe Nationale Industrielle Aerospatiale, Suresnes, France), and D. Gall (Centre d'Essais Aeronautiques Toulouse) *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 11 p refs In FRENCH (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The French Official Aeronautical Services originated a flight test program using the METEOR NF11 aircraft. The program is designed to reduce the radioelectric perturbations of an electrostatic origin. Antistatic protection of an aircraft consists of making the insolated parts of the structure conductive on the surface and installing dissipators of the potential. The flight experiments were preceeded by ground tests of high tension polarization in order to simulate the effects of triboelectricity. Dissipation of the potential was tested by making the entire aircraft conductive. Some instrumented dielectric panels were then put into place by detecting the eventual appearance of rampant electric discharges. Some general results from these tests are presented. Transl. by A.R.H.

N81-16161# United Kingdom Atomic Energy Authority, Abingdon (England).
THE BEHAVIOR OF CFRP PANELS IN METAL AIRCRAFT DURING SIMULATED LIGHTNING STROKES
B. J. C. Burrows and A. W. Hanson *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 7 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The current flow-pattern in a CFRP panel and the surrounding metal skin changes significantly during a current pulse simulating a lightning stroke. Measurements of the current distribution changes are made and compared with a theoretical treatment. The effects of different lay-ups of CFRP and different methods of mounting the panel are described. Observations are made of the influence of thin metal foils used to cover the outer surface on the screening provided by CFRP panels to simulated lightning current pulses. Screening by complex panels consisting of an aluminum honeycomb sandwiched between two CFRP skins is compared with these results. The direct damage suffered by both types of panels is also described, and their behavior analyzed theoretically. Author

N81-16162# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Dept. of Antenna.
INFLUENCE ON ANTENNA GAIN AND POLARIZATION PURITY OF REFLECTORS MANUFACTURED FROM CARBON FIBRE COMPOSITE MATERIALS
L. Heichele *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 15 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The effects on the RF antenna performance of reflectors manufactured out of carbon fiber reinforced plastics (CFRP) were investigated by experimental work. The test equipment used are described and an extensive number of results are given. The measurements cover the frequency range from 2 GHz to 18 GHz. The polarization dependency of loss and the effects on the phase are given for different CFRP types. The RF tests of a realized offset reflector satellite antenna manufactured from CFRP with an aperture diameter of 2 m are described. The measured far field characteristics are shown and compared with theoretical results and CFRP sample measurements. Author

N81-16163# Boeing Commercial Airplane Co., Seattle, Wash.
LIGHTNING THREAT DEFINITION FOR COMPOSITE AIRCRAFT
Preston Geren *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 12 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

An approach for calculating the transients induced in aircraft avionic systems by lightning is presented. The method was applied to an aircraft geometry having various combinations of metal and graphite-epoxy structure. The effects of graphite-epoxy joints are considered. Results are shown for common mode open circuit voltage and short circuit current induced on two representative wire bundles (cockpit to tail and cockpit to wingtip). The approach employs standard analytical techniques from transmission line theory and antenna theory to obtain lightning induced fields on the airframe surface, including the effects of airframe resonance. Both the directly attached and nearby lightning strikes are considered. A method for obtaining the concentration of fields as a result of noncylindrical geometries (e.g., along the leading and trailing edges of a wing) is described. The physical coupling mechanisms for penetration of exterior lightning induced electromagnetic fields into the aircraft interior are explained. Author

N81-16164# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Directorate of Avionics Engineering.
ELECTRICAL/ELECTROMAGNETIC CONCERNS ASSOCIATED WITH ADVANCED COMPOSITE MATERIALS IN AEROSPACE SYSTEMS
Christopher L. Blake and John C. Corbin, Jr. *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 8 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

The potential electrical/electromagnetic impacts created by the application of advanced composite materials to aerospace systems are assessed. The assessment was specifically limited to two predominantly used varieties of graphite composite materials, GY-70 and T-300, and to Kevlar. The GY-70 has the higher conductivity and is used primarily on missiles and spacecraft. The T-300 grade has a slightly lower conductivity than GY-70 and is the material commonly applied to aircraft based upon its mechanical properties. Kevlar, a dielectric material, has varied aircraft, missile, and spacecraft application. Specific areas of electrical/electromagnetic concern were surveyed. As a result of the survey, a number of significant concerns were defined. There are, however, no show stoppers in the use of composite materials. Leading concerns include shielding effectiveness, joint design, fuel tank design, power system grounding, low frequency antenna performance, analytical techniques, combined space

environment effects, and design guides. Recommended actions include technology development programs and the establishment of a combined Tr-Service/NASA effort to address the composite electrical/electromagnetic technical base and to collect, analyze, and distribute related data, establish standard test methods, develop design guides/handbooks, and develop applicable specifications/standards. E.D.K.

N81-16165# Naval Air Systems Command, Washington, D. C.
IN DEPTH STUDIES OF COMPOSITE AIRCRAFT ELECTROMAGNETIC PERFORMANCE
J. A. Birken *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 18 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

Unprotected graphite/epoxy aircraft avionics are significantly more vulnerable to lightning strikes than metallic aircraft while only slightly more vulnerable to nuclear EMP. The addition of a thin highly conductive metallic coating on the surface of the aircraft can significantly reduce this vulnerability. The additional reduction may be readily obtained with currently available box hardening devices. Composite aircraft hardening solely with devices is questionable. The use of a minimal weight savings penalty selection of coatings, hardened joints, and device hardening results in aircraft electromagnetically safe from radar, nuclear EMP, lightning, and severe future electromagnetic environments. E.D.K.

N81-16166# Syracuse Research Corp., N. Y.
ELECTROMAGNETIC COUPLING TO ADVANCED COMPOSITE AIRCRAFT WITH APPLICATION TO TRADE-OFF AND SPECIFICATION DETERMINATION
R. Wallenberg, E. Burt, and G. Dike *In* AGARD Electromagnetic Effects of (Carbon) Composite Mater. Upon Avionics Systems Oct. 1980 22 p refs (For primary document see N81-16144 07-24)
Avail: NTIS HC A16/MF A01

A major concern with the increasing use of composite materials and low voltage electronics is the amount of electromagnetic coupling to the interior of an aircraft and to the cables and electronic devices within it. Simple methods are described for determining the shielding provided by an aircraft's exterior surface and the coupling of the interior fields to cables and transmission lines within aircraft cavities. The results can be used to determine tradeoffs between electromagnetic shielding, weight, and cost. E.D.K.

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N81-16167 Massachusetts Univ., Amherst.
DC ARGON PLASMA AS AN ELEMENT-SELECTIVE GAS CHROMATOGRAPHIC DETECTOR, PART 1. OPTICAL SYSTEM DESIGN FOR RADIALLY RESOLVED SPARK STUDIES, PART 2 Ph.D. Thesis
Carol Ann Poirier 1980 316 p
Avail: Univ. Microfilms Order No. 8101381

Two electrode configurations of a DC argon plasma discharge, the two electrode Plasmajet and the three electrode Spectrajet 3, were evaluated as excitation sources for use in spectroscopic element selective gas chromatographic detector systems. Detection limits and selectivity ratios with respect to carbon, in the gas chromatographic detector mode, were determined for compounds containing the following elements: Si, B, Hg, P, Ge, Sn, and Pb. Detection limits were typically on the order of nanograms of selected element per second and selectivity ratios, with respect to carbon, on the order of 10,000 to 1,000,000. Dissert. Abstr.

N81-16168 Minnesota Univ., Minneapolis.
CHEMICAL EFFECTS IN ION SCATTERING SPECTROMETRY Ph.D. Thesis
Dale Larry Christensen 1980 224 p
Avail: Univ. Microfilms Order No. 8102080

Chemical bonding effects in ion scattering spectrometry are discussed. These effects are manifested in the oscillatory scattered ion yield curves as a function of incident ion energy for helium ions scattered from selected compounds. The discrete Fourier transform was used to convert the oscillatory scattered ion yield from the energy domain to the frequency domain. This transformation allowed the comparison of yield curves in a quantitative manner. Computer techniques were used to prepare the ion yield curves for the Fourier transform and to operate on the resulting spectral density functions. Programs were used to digitize, normalize, change abscissa, calculate and remove trends, calculate square roots and interpolate. Differences exist in many cases between the scattered ion yields or, more specifically, the magnitude spectral density functions for the compounds of indium and lead show distinct differences in their spectra and provide the potential for analysis of the chemical matrix in many cases. Dissert. Abstr.

N81-16169 Cincinnati Univ., Ohio.
THE DEVELOPMENT OF LABORATORY MICROCOMPUTER SYSTEMS Ph.D. Thesis
John Paarup Andersen 1980 118 p
Avail: Univ. Microfilms Order No. 8029649

Software developed to support the microcomputer system and the application of the microcomputer to electron spin resonance spectroscopy and double potential step chromocoulometry are described. Data acquisition and instrument control are performed by assembly language routines in most cases since they can be written to operate in real time. The BASIC interpreter used in this laboratory was modified such that assembly language routines could be embedded into the BASIC interpreter. This allowed the interpreter to control instruments and acquire data in real time. This real time BASIC interpreter proved to be useful. Dissert. Abstr.

N81-16170 Kansas State Univ., Manhattan.
RAMAN MICROPROBE ANALYSIS Ph.D. Thesis
John Joseph Blaha 1980 212 p
Avail: Univ. Microfilms Order No. 8102490

A Raman microprobe is used to observe the normal Raman effect from single microparticles. The resulting spectra of the Raman scattered light are characteristic of molecular and crystal vibrations in the solid and are the basis for the qualitative identification of major molecular constituents. Particles composed of a broad range of compounds exhibit vibrational Raman spectra and can be identified spectroscopically by comparison with spectra obtained from known particles or by reference to Raman data available for bulk samples. The application of Raman spectroscopy to the analysis of small, single particles offers the opportunity for the determination of the chemical states of the major elements present. This capability for speciation of a wide range of molecular components is not available from other microprobe techniques which furnish primarily elemental composition data only. The instrument and technique are applied to molecular microanalysis of individual particles in various types of samples. Dissert. Abstr.

N81-16171 California Univ., Berkeley.
DIFFUSION FLAME PARTICULATE VOLUME FRACTIONS Ph.D. Thesis
Steven Bard 1980 144 p
Avail: Univ. Microfilms Order No. 8029323

Flame radiation, the dominant mode of heat transfer in full scale fires, is controlled primarily by the fraction of the flame volume occupied by solid carbon. Particulate volume fractions, fv, are measured in situ in small scale, O(10 cm) buoyant diffusion flame pool fires supported in air by solid polystyrene, polypropylene, PMMA, wood, cellular polystyrene, two cellular polyurethanes and liquid isooctane, acetone and alcohol. Multiwavelength laser transmission measurements are used to determine an approximate two parameter particle size distribution. Measurements of laser induced fluorescence in these flames indicate that absorption by gas species is negligible compared to particulate absorption and scattering. Mean particle sizes obtained for all the fuels indicate

that it is a reasonable approximation to use the Rayleigh small particle absorption limit assumption to determine flame emissivity since the flame emission will be underestimated by only O(10 percent). Dissert. Abstr.

N81-16172 Princeton Univ., N. J.
IGNITION OF COMBUSTIBLE MIXTURES BY METAL PARTICLES Ph.D. Thesis
Yu-Pen Su 1980 121 p
Avail: Univ. Microfilms Order No. 8101557

The ignition of a combustible mixture by a hot or burning metal particle is studied. The critical size below which no ignition of combustible mixture is possible is determined in terms of the physical chemical properties of the mixture. The methods are used to solve the governing equations of the problem. In the first method, the governing equations are cast in dimensionless form and numerically integrated. The solutions are found to behave differently for particle temperatures higher or lower than the adiabatic flame temperature of the mixture. In the second method, a simplified model is solved analytically by the method of matched asymptotic expansions. It is found that the analytic solution gives a good approximation to the numerical solution in a certain range of the nondimensional parameters. Dissert. Abstr.

N81-16173 Princeton Univ., N. J.
CONVECTIVE IGNITION OF PROPELLANT CYLINDERS IN A DEVELOPING CROSS FLOW FIELD Ph.D. Thesis
Aviezer Birk 1980 192 p
Avail: Univ. Microfilms Order No. 8101531

Convective ignition and flame spreading phenomena on propellant cylinders in cross flow under high heat transfer rates (e.g., 100 cal/sq cm/sec. In particular, the sensitivities of ignition delay time and site to the ambient conditions (i.e., flow velocity, pressure, temperature and gas composition) are investigated. A shock tunnel was used to provide up to 20 ms of flowing heated gas at 1 to 22 MPa, 1800 to 2300 K, 5 to 300 m/s. Test gases are 100%N2, 10%O2/90%N2 and 50%N2. Instrumentation included radiation detectors, high speed shadowgraph sequences, pressure probes and heat flux gauges. Most of the tests were conducted with nitrocellulose based propellants. Also, tests were conducted with propellants in tandem configurations.
Dissert. Abstr.

N81-16174*# National Aeronautics and Space Administration. Pasadena Office, Calif.
A METHOD FOR PRODUCING A SOLIDIFIED BODY OF SILICON Patent Application
Kazuo A. Yamakawa (JPL) and Ralph Lutwack, inventors (to NASA) (JPL) Filed 24 Dec. 1980 13 p
(Contract NAS7-100)
(NASA-Case-NPO-15250-1; US-Patent-Appl-SN-219639) Avail: NTIS HC A02/MF A01 CSCL 07D

A method is disclosed for producing solidified bodies from fluid material such as producing a polycrystalline body of silicon from submicron silicon powder, as well as various silicon compounds. A pedestal of a generally cylindrical configuration is supported for rotation beneath a heating unit for purposes of establishing a layer of molten material into which is deposited a stream of submicron silicon powder from a tube. The material of the layer is incrementally frozen as the pedestal is lowered. A more usable form of silicon is provided for use in the solar cell industry. NASA

N81-16175*# Hamilton Standard, Windsor Locks, Conn.
PHASE DIAGRAM OF KHF2 AND NON-EQUILIBRIUM EFFECTS Final Report
Melvin C. Hobson and Jordan D. Kellner Oct. 1978 55 p refs
(Contract NAS2-9273)
(NASA-CR-152192; SVHSER-7206; R78-313686-8) Avail: NTIS HC A04/MF A01 CSCL 07D

The equilibrium diagram for the KHF2-H2O system was constructed from cooling and heating curves for the compositions between 5 wt% and 40 wt% KHF2 and the results are shown. The phase diagrams shown is typical of that of a two component system with miscible liquid phases and whole solid phases consist of pure components. A eutectic point was found at approximately 15% KHF2 which remains completely liquid down to a temperature of -9.0 C. No hydrate formation was observed and no anomalous behavior such as the occurrence of solid transitions or metastable states was observed. The effect of rapid freezing on the equilibrium diagram did not appear, and cooling curves exhibited only one halt. Also, at rapid freezing rates, the supercooling of the solutions was smaller than those observed at the slow cooling rates. The existence of a eutectic composition and the slow rate of dissolution of the salt are used to interpret heat absorption behavior in practical applications of the KHF2-H2O system. J.M.S.

N81-16176*# Tennessee Technological Univ., Cookeville. Dept. of Engineering Science and Mechanics and Mechanical Engineering.
PERTURBATION SOLUTIONS OF COMBUSTION INSTABILITY PROBLEMS
A. Googerdy, J. Peddieson, Jr., and M. Ventrice Oct. 1979 66 p refs
(Grant NGR-43-003-015)
(NASA-CR-159643) Avail: NTIS HC A04/MF A01 CSCL 21B

A method involving approximate modal analysis using the Galerkin method followed by an approximate solution of the resulting modal-amplitude equations by the two-variable perturbation method (method of multiple scales) is applied to two problems of pressure-sensitive nonlinear combustion instability in liquid-fuel rocket motors. One problem exhibits self-coupled instability while the other exhibits mode-coupled instability. In both cases it is possible to carry out the entire linear stability analysis and significant portions of the nonlinear stability analysis in closed form. In the problem of self-coupled instability the nonlinear stability boundary and approximate forms of the limit-cycle amplitudes and growth and decay rates are determined in closed form while the exact limit-cycle amplitudes and growth and decay rates are found numerically. In the problem of mode-coupled instability the limit-cycle amplitudes are found in closed form while the growth and decay rates are found numerically. The behavior of the solutions found by the perturbation method are in agreement with solutions obtained using complex numerical methods. Author

N81-16177*# Aerojet Liquid Rocket Co., Sacramento, Calif.
HIGH-DENSITY FUEL COMBUSTION AND COOLING INVESTIGATION Final Report, Oct. 1977 - Aug. 1980
Rich J. LaBotz, Don C. Rousar, and Harry W. Valler Sep. 1980 114 p refs
(Contract NAS3-21030)
(NASA-CR-165177) Avail: NTIS HC A06/MF A01 CSCL 21B

The analysis, design, fabrication and testing of several engine configurations are discussed with respect to the combustion and heat transfer characteristics of LOX/RP-1 at chamber pressures between 6895 and 13790 kPa (1000 and 2000 psia). The different engine configurations discussed include: 8274 kPa and 13790 kPa (1200 psia and 2000 psia) chamber pressure injectors with like doublet and preatomized triplet elements; cooled and uncooled acoustic resonators; and graphite, regeneratively cooled and calorimetric chambers ranging in length from 27.9 to 37.5 cm (11 to 15 in.). A high pressure LOX/RP-1 spark igniter is also evaluated. R.C.T.

N81-16178# Naval Research Lab., Washington, D. C.
DETAILED MODELLING OF COMBUSTION SYSTEMS Interim Report
Elaine S. Oran and Jay P. Boris 12 Nov. 1980 226 p refs (RR0240241)
(AD-A092234; NRL-MR-4371) Avail: NTIS HC A11/MF A01 CSCL 21/2

The purpose of this paper is to acquaint the reader with some of the basic principles of detailed modeling as applied to combustion systems. Detailed modeling is also known as numerical simulation. It can be used to describe the chemical and physical evolution of a complex reactive flow system by solving numerically the governing time-dependent conservation equations for mass, momentum and energy. Solving these equations requires input data such as the species present, the chemical reactions that can occur, transport coefficients for viscosity, thermal conductivity, molecular diffusion and thermal diffusion, the equation of state

for the various materials present and a set of boundary, source and initial conditions. Given this information, the equations contain in principle all the information we might want from the largest macroscopic space scales down to the point where the fluid approximation itself breaks down. Flame, detonation, turbulence phenomena and all multidimensional effects are included in the solutions of these equations. An important goal of detailed modeling is to develop a computational model with a well-understood range of validity. This model can then be used in a predictive role to evaluate the feasibility and validity of new concepts. It can also be used to interpret experimental measurements, to extend our knowledge to new parameter regimes and perhaps as an engineering design tool. Throughout these various applications the model may serve as an excellent way to test our understanding of the interactions of the individual physical processes which control the behavior of a reactive flow system. GRA

N81-16179# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

FLAMELESS ATOMIC ABSORPTION SPECTROSCOPY: EFFECTS OF NITRATES AND SULFATES M.S. Thesis - Texas Univ. at Austin

Nils Akerlind, Jr. May 1980 143 p refs

(AD-A092419; AFIT-CI-80-15T) Avail: NTIS HC A07/MF A01 CSCL 07/4

Like other analytical techniques, flameless atomic absorption is subject to matrix or interference effects. Upon heating, nitrate and sulfate salts decompose to generate oxidizing species such as nitrogen dioxide or sulfur trioxide. These concomitant oxidants are capable of gas phase reactions with the analyte atoms, thereby reducing the analyte free atom concentration and thus decreasing the analyte absorbance signal. The effects of sodium nitrate, potassium nitrate, sodium sulfate or potassium sulfate on the absorbance signal of iron, nickel, tin, chromium, silver, and copper was studied utilizing both the graphite filament atomizer and the graphite furnace atomizer. Thermodynamic calculations were employed to explain/predict the effects of oxygen on the analyte free atom concentration. An optical system was developed which allows the simultaneous measurement of the transient absorbance signal at various spatial zones with the commercial furnace atomizer. GRA

N81-16180# Texas Univ. at Austin. Dept. of Chemistry.

PHOTOCATALYTIC REACTION OF WATER WITH CARBON OVER PLATINIZED TITANIA Technical Report, 1 Jan. - 31 Dec. 1980

S. Sato and J. M. White 10 Oct. 1980 23 p refs Submitted for publication

(Contract N00014-75-C-0922; NR Proj. 056-578)

(AD-A092222; TR-17) Avail: NTIS HC A02/MF A01 CSCL 07/9

The reaction of gas phase water with active carbon over illuminated, platinized TiO2 (anatase powder) is studied at room temperature and 60 C. The products are H2, CO2 and a small amount of O2. As the reaction proceeds, the rate declines due to the accumulation of H2 and the loss of a good contact between the catalyst and carbon. When the reaction is carried out in liquid H2O, the oxidation of carbon is inhibited and O2 as well as H2 evolves. GRA

N81-16181# Texas Univ. at Austin. Dept. of Chemistry.

ON THE PHOTOASSISTED HYDROGEN PRODUCTION FROM TITANIA AND WATER Technical Report, 1 Jan. - 31 Dec. 1980

S. Sato and J. M. White 12 Nov. 1980 17 p refs Submitted for publication

(Contract N00014-75-C-0922)

(AD-A092223; TR-18) Avail: NTIS HC A02/MF A01 CSCL 07/2

When TiO2, reduced by H2 or CO, is placed in an ambient of gas phase water and illuminated with band gap light, H2 is evolved. Adding a small amount of O2 completely retards this reaction. A dark reaction of reduced TiO2 with water to form H2 also occurs at temperatures above 200 C. These results show that H2 evolution is not the result of catalytic water photolysis but a photoassisted reaction of water with oxygen vacancies produced by the reduction. GRA

N81-16182# Washington Univ., Seattle. Lab. for Chemometrics.

UFVA, A COMBINED LINEAR AND NONLINEAR FACTOR ANALYSIS PROGRAM PACKAGE FOR CHEMICAL DATA EVALUATION Interim Report, Aug. - Nov. 1980

Clements Jochum and Bruce R. Kowalski Nov. 1980 27 p refs Submitted for publication

(Contract N00014-75-C-0536; NR Proj. 051-565)

(AD-A092213; TR-18) Avail: NTIS HC A03/MF A01 CSCL 07/4

UFVA, an underlying variable factor analysis program is described. The theories of principal component analysis and nonlinear least squares projection techniques are outlined and compared. Several applications from various chemical fields are presented which show that a complete analysis of the underlying structure and dimensionality of a chemical data set should always include these nonlinear projection techniques. GRA

N81-16183# Indiana Univ. at Bloomington. Dept. of Chemistry.

FACILE CLEAVAGE OF THE Mo IDENTICAL WITH Mo BOND IN REACTIONS BETWEEN Mo2(OBu-t)6 AND ARYL AZIDES AND MOLECULAR OXYGEN

Malcolm H. Chisholm, Kirsten Folting, John C. Huffman, Charles C. Kirkpatrick, and Andrew Ratermann 31 Oct. 1980 10 p refs Submitted for publication

(Contract N00014-76-C-0826)

(AD-A092323; TR-80-6) Avail: NTIS HC A02/MF A01 CSCL 07/3

Product 1 is structurally related to (MoMe2(NBu(-))2)2 recently characterized by Nujent and Harlow; Product 2, the tert-butyl ester of molybdic acid, is the first molecular of its kind to be prepared for the group 6 transition elements. GRA

N81-16184# Illinois Univ. at Urbana-Champaign. Dept. of Chemistry.

CHEMILUMINESCENCE OF SECONDARY PEROXYESTERS

Brian G. Dixon and Gary B. Schuster 14 Nov. 1980 50 p refs

(Contract N00014-76-C-0745)

(AD-A092322) Avail: NTIS HC A03/MF A01 CSCL 07/4

The thermolysis of 1-phenylethylperoxyacetate and a series of substituted 1-phenylethylperoxybenzoates was investigated. Thermolysis in benzene gives acetophenone and the corresponding carboxylic acid. The study of the reaction kinetics and kinetic isotope effect indicate that the unimolecular thermolysis proceeds by homolysis of the oxygen-oxygen bond. Electronically excited states are formed in the thermolyses of these peroxyesters. These are detected by their characteristic direct chemiluminescence or by indirect chemiluminescence. In the presence of easily oxidized catalysts these peresters give excited states by the chemically initiated electron-exchange luminescence (CIEEL) path. The mechanism of these luminescent reactions was investigated. GRA

N81-16185# Illinois Univ. at Urbana-Champaign. Dept. of Chemistry.

ON THE FREE-ENERGY RELATIONSHIPS FOR REVERSIBLE AND IRREVERSIBLE ELECTRON TRANSFER PROCESSES

Franco Scandola, Vincenzo Balazani, and Gary B. Schuster 14 Nov. 1980 27 p refs

(Contract N00014-76-C-0745)

(AD-A092356) Avail: NTIS HC A03/MF A01 CSCL 07/4

The relationship between the free energy change and the activation energy for electron transfer reactions is examined. Two general classes, reversible and irreversible, processes are discussed, and the relation between them studied. An analysis of the differences between linear and non-linear free energy relationships is presented. GRA

N81-16186# Illinois Univ. at Urbana-Champaign. Dept. of Chemistry.

CHEMICALLY INITIATED ELECTRON-EXCHANGE LUMINESCENCE

Gary B. Schuster and Keith A. Horn 14 Nov. 1980 35 p refs

(Contract N00014-76-C-0745)

(AD-A092355) Avail: NTIS HC A03/MF A01 CSCL 07/4

The mechanism of chemiluminescence for diphenoyl peroxide and dimethyldiozetanone is reviewed. Heavy emphasis is placed on the chemically initiated electron exchange luminescence mechanism. GRA

N81-16187# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.

ANALYSIS OF COMBUSTION AND HEAT TRANSFER IN A POROUS GRAPHITE MEDIUM M.S. Thesis

Costa Sozon Vatikiotis Jun. 1980 158 p refs

(AD-A092094) Avail: NTIS HC A08/MF A01 CSCL 11/4

The problem of a porous graphite fiber plate subject to combustion is formulated. The transient one dimensional model leads to two heat transfer equations on the graphite and air, and a mass transfer equation on the oxygen. In addition to a combustion heat generation term, the heat transfer model includes the mechanisms of conduction, radiation between fibers, and convection due to induced air flow through the mat. The mass transfer model includes diffusion and convection mechanisms, as well as a combustion consumption term. The temperature dependency of the system parameters is taken into account. The resulting nonlinear, coupled partial differential equations are solved by a Galerkin formulation of the finite element method. A number of computer analysis results are presented. The results show the effects of initial conditions, plate thickness, fiber diameter and air flow rate on ignition and extinction. GRA

N81-16188# Naval Academy, Annapolis, Md.

DEEP LEVEL TRANSIENT SPECTROSCOPY AS AN EXPERIMENTAL TECHNIQUE Final Report, 1979 - 1980

Stephen Lester Spehn 5 Jun. 1980 46 p refs

(AD-A091941; USNA-TSPR-109) Avail: NTIS HC A03/MF A01 CSCL 09/4

Deep Level Transient Spectroscopy (DLTS) is becoming a popular method of studying defect trapping states in semiconductors. DLTS is sensitive, rapid, and straightforward to analyze; it is able to distinguish between traps of different energy levels as well as different capture cross sections; and it is versatile in that it can provide any desired information on a given defect and can cover a large spectrum of energy levels. DLTS can be used on any type of semiconductor with little or no change in system setup. This makes it both a convenient and powerful technique. This report studies the DLTS technique and introduces a mathematical model of the DLTS data analysis which until now has been somewhat limited in scope. This analysis is considered under a wide range of system setups and its effects are shown graphically. The source of error which causes the greatest uncertainty in results in DLTS is found to be the accuracy with which the applied phase shift can be measured. The results are found to vary by one percent per degree of phase shift. The system is then used to evaluate trapping states in a sample of Silicon and a sample of GaAlAs. For the Silicon the Energy Level is .433 eV with a prefactor of 1.11 x 10 to the 7th power. For the GaAlAs the Energy Level is .59 eV with a prefactor of 5.24 million. GRA

N81-16189# State Univ. of New York at Buffalo. Dept. of Chemistry.

DIFFUSION-CONTROLLED CURRENT AT THE STATIONARY FINITE DISK ELECTRODE: THEORY

Koichi Aoki and Janet Osteryoung Oct. 1980 43 p refs Submitted for publication

(Contract N00014-79-C-0644; NR Proj. 056-722)

(AD-A091931; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

Rigorous expressions for diffusion-controlled currents at a stationary finite disk electrode are derived through use of the Winer-Hofp technique. The chronoamperometric curve obtained varies smoothly from a curve represented by the Cottrell equation to a steady state value similar to that obtained for a spherical electrode as time elapses. The solution can be expressed also as the Cottrell term multiplied by a power series in the parameter sq. rt (Dt/a), where a is the electrode radius. The present work is discussed in terms of the coefficient of the first term in this formulation. GRA

N81-16190# Auburn Univ., Ala. Dept. of Chemistry.

CARBORANE BURNING RATE MODIFIERS Final Report, Aug. 1975 - Jun. 1979

William E. Hill and F. A. Johnson 20 Mar. 1980 30 p

(Contract N00024-75-C-5318)

(AD-A092618) Avail: NTIS HC A03/MF A01 CSCL 07/3

Because of the high cost of o-carboranes a kinetic study designed to find out the mechanism of the reaction and to elucidate the factors influencing the reactions was carried out. The goal of this study was to provide information that would allow high yield syntheses of o-carboranes. It was found that acetylenes with electronegative substituents gave highest yields of o-carborane. Therefore, functional acetylenes such as HC = CCH2Br should be used to prepare precursors to other functional carboranes. Since migration of some carboranes out of solid propellants has been observed, a study was undertaken to synthesize functional carboranes capable of adding to polybutadiene binder successfully. However, the polymer properties were greatly altered and were therefore not acceptable for propellant studies. GRA

N81-16191# Princeton Univ., N. J. Guggenheim Aerospace Propulsion Labs.

MULTIPLE IGNITION, NORMAL AND CATALYTIC COMBUSTION AND QUENCHING OF FUEL/AIR MIXTURES Annual Report

C. Burns, F. V. Bracco, H. S. Homan, and W. A. Sirignano 10 May 1980 63 p refs

(Grant AF-AFOSR-3052-76; AF Proj. 2308)

(AD-A092738; AFOSR-80-1251TR) Avail: NTIS HC A04/MF A01 CSCL 21/2

Lean combustion of propane in platinum/alumina/cordierite catalysts has been studied at atmospheric pressure, gas velocities of 10-40 m/s, C3H8 equivalence ratios of .19 to .32 and H2O concentration of 1.2 to 1.7 mol %. Measurements of substrate temperature and gas composition, pressure and temperature inside and downstream of the catalyst have been made. The dependences of substrate temperature, gas temperature, and gas composition of inlet temperature, reference velocity and equivalence ratio have been investigated. A two dimensional model of the gas-phase including the effect of finite-rate chemical kinetics at the substrate surface has been developed and tested. When the experimental wall temperature is used as boundary condition for the gas-phase equations, the emission predictions are in reasonably good agreement with the measured ones. The indications obtained from the model are that propane is oxidized via a multi-step kinetic mechanism, that in the range of temperatures and equivalence ratios explored most of the fuel is burnt at the catalytic wall rather than in the gas phase and that wall kinetics is slower than gas diffusion transport. GRA

N81-16192# Sheffield Univ. (England). Dept. of Chemical Engineering and Fuel Technology.

BREAK UP OF VORTEX RINGS IN IMPINGING TURBULENT JET FLAMES Annual Technical Report, Apr. 1979 - Apr. 1980

A. J. Yule and N. A. Chigier Apr. 1980 21 p refs

(Grant DA-ERO-79-G-031; DA Proj. 1T1-61102-BA-57)

(AD-A092619) Avail: NTIS HC A02/MF A01 CSCL 21/2

The objective of this experimental investigation is to examine the structure of turbulent flow in jet flames impinging on flat walls with particular emphasis on the formation and break up of vortex ring-like eddies. Experiments include the study of heat transfer to the wall and the influence of eddies on the mechanism of heat transfer with variation in flow geometry and burner initial conditions. During the first year of research a new flame-impingement rig has been commissioned, preliminary flow visualizations have been made showing flame structure over a wide range of conditions. Considerable data have been obtained in non-impinging flames which will later be compared with impinging flame data. As a result of this preliminary work it is found that ring vortex eddies are identified in impinging flames for a wide range of flow geometries, equivalence ratios and types of gaseous fuel. These eddies break up into 'flamelets' which remain coherent for long distances. These coherent structures require further investigation because they must strongly influence heat transfer to the wall and fluctuations in gas

temperature near the wall. Similar structures have been identified and measured in non-impinging flames. GRA

N81-16193# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
THE EFFECT OF STRESS ON HYDRIDE PRECIPITATION
Ted B. Flannagan, N. B. Mason, and H. K. Birnbaum Nov. 1980 8 p refs Prepared in cooperation with Vermont Univ., Burlington
(Contract N00014-75-C-1012)
(AD-A092889) Avail: NTIS HC A02/MF A01 CSCL 07/2

A major difficulty in comprehending the mechanism of stress induced hydride fracture has been brought to the attention of one of the authors (HKB) by the other two. This difficulty has arisen because a clear distinction was not made between uniformly and non-uniformly stressed situations in the metal-hydrogen systems previously discussed. Since this distinction is a crucial one in understanding the proposed fracture mechanism, an attempt will be made here to resolve this difficulty. In addition, the discussion will encompass some general aspects of the effects of stress on hydride precipitation. GRA

N81-16194# Rockwell International Corp., Golden, Colo. Energy Systems Group.
A SEARCH FOR AN IN-LINE NITRIC ACID ANALYZER
Karin Y. Gallagher and Charles M. Johnson 28 Oct. 1980 24 p refs
(Contract DE-AC04-76DP-03533)
(RFP-2986) Avail: NTIS HC A02/MF A01

A literature search was conducted to identify possible techniques for measuring mineral acid normality in the presence of heavy metal salts, undissolved solids, and high radiation fields. Of the techniques noted, eight were identified that could be applicable to the objective. The possibilities were reduced to two methods, which warrant further investigation. These two are refractometry and a modified coulometric-polarographic method. All methods are discussed in detail followed by rationale for including or rejecting each for further investigation. Author

N81-16195# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
KINETIC AND SYNTHETIC STUDIES ON BORON-NITROGEN HYDRIDES Ph.D. Thesis
Thomas Stafford Briggs Sep. 1980 47 p refs
(Contract W-7405-eng-48)
(LBL-11494) Avail: NTIS HC A03/MF A01

The acid catalyzed ammonolysis of hydroborate ion was studied in warm liquid ammonia solution, in the ammonium ion concentration range 0.001-0.8 M. The reaction of BH4(-) with NH4(+) to yield NH3BH3 was found to be first order in both ions. The second order rate constant in a solution of ionic strength 0.2 at 30C is 1.94 x 10 to the minus 4/M/sec. Varying the ionic strength at 30C gave rate constants that followed the Bronsted-Bjerrum relationship below an ionic strength of 0.9. The rate was studied in the range 25-45C, and the activation energy was determined to be 28.5 kcal/mol. R.C.T.

N81-16196# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
WAVE MIXING SPECTROSCOPY Ph.D. Thesis
Robert William Smith Aug. 1980 184 p refs
(Contract W-7405-eng-48)
(LBL-11518) Avail: NTIS HC A09/MF A01

It was shown theoretically that polarization sensitive detection may be used to either eliminate or controllably reduce the nonresonant background in coherent anti-Stokes Raman spectroscopy (CARS), allowing weaker Raman resonances to be studied. These four wave mixing techniques are called background suppression CARS and optical heterodyned detection CARS. These were experimentally demonstrated by studying the 992/cm Raman mode of benzene diluted in carbon tetrachloride, with an attained detection sensitivity of 100 ppm of benzene. This corresponds to a ratio of resonant to nonresonant susceptibilities of about .004. A discussion of experimental techniques, possible applications, and limitations of these techniques are presented. T.M.

N81-16197# California Univ., Berkeley. Materials and Molecular Research Div.
THE PHOTOCHEMISTRY AND KINETICS OF GAS PHASE REACTIONS INVOLVING HO AND CI RADICALS Ph.D. Thesis
Herbert Hoffman Nelson Nov. 1980 155 p refs
(Contract W-7405-eng-48)
(LBL-11666) Avail: NTIS HC A08/MF A01

The kinetics of the reaction of the HO radical with HNO3 and H2O2, the kinetics of Cl atom reactions with ClNO and ClNO2, and the photochemistry of ClNC2 and ClOO2 were examined. The ultraviolet absorption cross sections of NHO3 and ClNO2 were also determined. The radicals were produced by pulsed laser photolysis of the appropriate precursors in a slow flow system and the time evolution of their concentrations was monitored by the technique of atomic or molecular resonance fluorescence. R.C.T.

N81-16198# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
THE APPLICATION OF HIGH RESOLUTION ELECTRON ENERGY LOSS SPECTROSCOPY TO THE CHARACTERIZATION OF SMALL MOLECULES ADSORBED ON RHODIUM SURFACES Ph.D. Thesis
Lawrence Henry Dubois Jul. 1980 253 p refs
(Contract W-7405-eng-48)
(LBL-11357) Avail: NTIS HC A12/MF A01

High resolution electron energy loss spectroscopy (ELS), thermal desorption mass spectrometry (TDS), low energy electron diffraction and Auger electron spectroscopy were used to study various chemical processes. Particular emphasis is given to the following: (1) the chemisorption of CO, CO2 and O2 on the Rh(3) single crystal surface; (2) the bonding and chemical transformations of C2H2 and C2H4 on Rh(3); (3) the chemisorption and subsequent reactions of NO, O2 and CO on Rh(331), and (4) the chemisorption of CO on model alumina supported rhodium catalysts. The vibrational spectra of carbon monoxide on Rh(3) indicate two distinct binding sites (atop and bridged) whose relative populations and vibrational frequencies are determined by both the substrate temperature and the background pressure. The measurements show the bridge bonded CO to have an approximately 4 kcal/mole lower binding energy to the surface than the species located in the atop site. The adsorption of carbon dioxide yields virtually identical TDS and ELS spectra to that of chemisorbed CO, indicating dissociative adsorption. R.C.T.

N81-16199# California Univ., Livermore. Lawrence Livermore Lab.
CHEMICAL KINETICS AND MODELING OF COMBUSTION PROCESSES
Charles K. Westbrook and Frederick L. Dryer (Princeton Univ., N.J.) 18 Jul. 1980 49 p refs Presented at 18th Intern. Symp. on Combust., Waterloo, Canada, 17-22 Aug. 1980
(Contracts W-7405-eng-48; EC-77-5-02-4272; F49620-78-C-004)
(UCRL-84653; CONF-800809-4) Avail: NTIS HC A03/MF A01

Chemical kinetic modeling is an important tool in the analysis of many combustion systems. The use of detailed kinetic models in the interpretation of fundamental kinetics experiments in shock tubes and plug flow reactors is widespread. Recently these models, coupled with fluid mechanical models, have become valuable in helping to understand complex phenomena in practical combustion devices. The mechanisms used for the combustion of hydrocarbon fuels and some of the practical problems to which they are applied are reviewed. E.D.K.

N81-16200# Sandia Corp., Livermore, Calif. Combustion Sciences Dept.
A PHENOMENOLOGICAL DESCRIPTION OF PARTICULATE FORMATION DURING CONSTANT VOLUME COMBUSTION
T. Michael Dyer and W. L. Flower Nov. 1980 36 p refs Presented at Gen. Motors Res. Symp. on Carbon: Formation during Combust., Warren, Mich., 15-16 Oct. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-8663; CONF-8010135-3) Avail: NTIS HC A03/MF A01

Experiments to characterize soot particulate formation

processes during the combustion of rich homogeneous mixtures were conducted in a constant volume combustion bomb. Soot formation is observed to occur very rapidly in the flame front, and the particles are dispersed over the burned gas region as these gases are continually compressed. Particles sampled and analyzed by transmission electron microscopy exhibit three dimensional chain-like structures. In the present premixed experiments, any parameter change that increases the flame zone temperature, such as reducing the diluent concentration, decreasing the diluent heat capacity, increasing the initial reactant temperature, or changing the fuel type, reduces the quantity of soot formed. Thus, temperature is shown to be a key parameter in determining the tendency of a mixture to soot. In many of these tests, burned gas temperature is nearly constant with time, suggesting that particulate blackbody radiation may be a stabilizing influence on the burned gas temperature. Coupling this radiation back into the chamber influences the particulate oxidation process and actually reduces the quality of soot formed. E.D.K.

N81-16201# Oak Ridge Y-12 Plant, Tenn. Plant Lab. Dept.
MASS SPECTROMETER FOR THE ANALYSES OF GASES
J. R. Ferguson and E. R. Rogers 30 Jun. 1980 13 p refs (Contract W-7405-eng-26)
(Y-2214) Avail: NTIS HC A02/MF A01

A six inch radius, 60 deg magnetic sector mass spectrometer (designated as the MS-200) was constructed for the quantitative and qualitative analyses of fixed gases and volatile organics in the concentration range from 1 ppm (by volume) to 100 percent. A partial pressure of 0.000001 torr in the inlet expansion volume is required to achieve a useful signal at an electron multiplier gain of 10,000. Author

N81-16202# National Technical Information Service, Springfield, Va.
ELECTROCHEMICAL REACTIONS AT SURFACES. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Sep. 1980
Diane M. Cavagnaro Oct. 1980 153 p Supersedes NTIS/PS-78/1034
(PB81-800070; NTIS/PS-78/1034) Avail: NTIS HC $30.00/MF $30.00 CSCL 07D

The citations discuss battery electrode reactions, fuel cell reactions, electrochemical corrosion studies, catalyst reactions, chemisorption, theoretical analysis, electrical double layer and measurement techniques. Also included are some molten salt processes. GRA

N81-16203 Lehigh Univ., Bethlehem, Pa.
MICROPROCESSOR CONTROLLED SEMIINTEGRAL ELECTROCHEMISTRY Ph.D. Thesis
Edward Harry Schmauch 1980 247 p
Avail: Univ. Microfilms Order No. 8102516

Potential step electrochemical experimentation was performed utilizing a M6800 microprocessor system to collect current and semiintegral data at 0.250 ms invervals. The development of a floating point arithmetic package was necessary to enable the microprocessor system to perform the various tasks required. The semiintegral data was obtained both by utilizing an analog ladder network and by operation of a digital algorithm on the current data. Correction for charging current and electrode sphericity were implemented by software. A chronoamplometric study of cadmium ion reduction demonstrated that the apparatus developed in this laboratory is capable of obtaining semiintegral electrochemical data. Plots of current versus semiintegral in the time window where the current is experiencing kinetic control can be used to obtain electrode kinetic information. The kinetics of the Cr3 yields Cr2 reduction were studied by this technique. Dissert. Abstr.

N81-16204 Saint Louis Univ., Mo.
METHODS FOR THE USE OF A MICROPROCESSOR TO CAPTURE AND REFINE ABSORBANCE DATA FROM A CONTINUOUS-FLOW ANALYZER Ph.D. Thesis
William Bert Furman 1979 612 p
Avail: Univ. Microfilms Order No. 8101256

A detailed presentation of methods for monitoring the signal from a continuous flow analyzer with an inexpensive microprocessor system is given. The programs pick and print the absorbances of the starting baseline, each peak, and the final baseline. The effects of spikes and random noise are reduced by smoothing or weighting techniques. Error messages are printed if excessive noise is detected. There are several advantages in using a microprocessor at each continuous flow analyzer. Each microprocessor is set to acquire data at a rate optimized for its analyzer. Voltage noise or spikes was dealt with at the source with the refined data being stored in digitized form. Dissert. Abstr.

N81-16205 Texas A&M Univ., College Station.
RADIOACTIVE ION MICROSCOPY Ph.D. Thesis
Stanley Allen Johnson 1980 87 p
Avail: Univ. Microfilms Order No. 8101607

The characterization of specimens with a spatial resolution at the micron level is studied by radioactive ion microscopy, using a beam of radioactive ions, specifically tritium ions, of sufficient energy to pass through a thick specimen. After passage through the object, the ions are implanted in a stack of thin mylar sheets (1.5 microns thick). Their rest position is proportional to the thickness and the density of the sample transversed. The location of the radioactive species can be pinpointed by autoradiographing the successive mylar foils. Each picture represents a two dimensional segment of the tridimensional density image of the specimen. The radiographs are photographed and converted into digital data which is used to generate a density map of the object. From these plots, physical and chemical features may be deduced. The feasibility of RIM has been demonstrated with specimen images obtained from different objects exposed to a 3 MeV3H+ beam. Dissert. Abstr.

N81-16206 Washington Univ., Seattle.
VIDEO FLUOROMETRIC MONITORING OF HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC EFFLUENTS USING A UNIQUE SHEATH FLOW CUVETTE Ph.D. Thesis
Leon Wenger Hershberger 1980 158 p
Avail: Univ. Microfilms Order No. 8029760

The flow through cuvette for fluorescence detection of HPLC effluents is based on the sheath flow principle in which the chromatographic effluent is injected into the center of an ensheathing solvent stream, but does not mix with it because laminar flow conditions are maintained. A sheath flow cuvette which minimizes scattered light and optical volume is described. Stability, reproducibility, and linearity are investigated for the cuvette which has an optical volume between 6 and 150 nanoliters. Development of a larger version of the sheath flow cuvette with an optical volume variable between 1 and 20 microliters is described in the VFLC. Dissert. Abstr.

N81-16207 Washington Univ., Seattle.
THE METHOD OF RANK ANNIHILATION AND ITS APPLICATIONS TO QUANTITATIVE MULTICOMPONENT ANALYSIS OF FLUORESCENCE DATA Ph.D. Thesis
Chu-Ngi Ho 1980 197 p
Avail: Univ. Microfilms Order No. 8029761

The method of rank annihilation is proposed for quantitative analysis of multicomponent fluorescence data in the form of an excitation-emission matrix (EEM), such as that acquired by a Video Fluorometer. The method of rank annihilation is capable of quantifying a particular component known to be present in a mixture without having also to know the identities of the rest of the components which may be present. The method involves a simple subtractive procedure and observation of what happens to the residuals through their eigenvalues and eigenvectors. The method of rank annihilation is tested with diverse sets of experimental data with compositions of different complexities and comprising components of varying degree of spectral overlap and quantum efficiency. The application of the methodology and the allied criteria to test the reliability of the quantitative results are discussed. The extension of the method to perform simultaneous multicomponent rank annihilation using the Fletcher-Power algorithm in cases where one knows more than one component in a mixture is also presented. Dissert. Abstr.

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N81-16208 Pittsburgh Univ., Pa.
AN INVESTIGATION OF HOT CORROSION MECHANISMS IN NICKEL BASE ALLOYS Ph.D. Thesis
Tai Tsu Huang 1980 218 p
Avail: Univ. Microfilms Order No. 8028015

The mechanisms by which metals and alloys are attacked by gaseous environments when deposits are present on their surface were determined. A large number of different metal and alloy specimens were exposed to an oxygen atmosphere with various salt coatings, and oxidized specimens were examined by ordinary light and scanning electron microscopy to characterize the morphology and structure of the scale developed at various stages of oxidation. Alloy microstructure and oxidation products were identified through X-ray diffraction, electron diffraction and EDAX analysis techniques in order to obtain a more conclusive picture of the mechanism of hot corrosion. Dissert. Abstr.

N81-16209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED REFRACTORY COATINGS Patent Application
William A. Brainard, inventor (to NASA) Filed 29 Sep. 1980 8 p
(NASA-Case-LEW-23169-2; US-Patent-Appl-SN-191746) Avail: NTIS HC A02/MF A01 CSCL 11F

The adhesion, friction and wear properties of sputtered refractory coatings on substrates of materials that form stable nitrides are enhanced by placing each substrate directly below a titanium carbide target of a commercial radiofrequency diode apparatus in a vacuum chamber. Nitrogen is bled into the system through a nozzle resulting in a small partial pressure of about 0.5% to 2.5% during the first two minutes of deposition. The flow of nitrogen is then stopped, and the sputtering ambient is reduced to pure argon through a nozzle without interrupting the sputtering process. When nitrogen is deliberately introduced during the crucial interface formation, some of the titanium at the interface reacts to form titanium nitride while the metal of the substrate also forms the nitride. These two nitrides atomically mixed together in the interfacial region act to more strongly bond the growing titanium carbide coating as it forms on the substrate. NASA

N81-16210*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF ERODANT PARTICLE SHAPE AND VARIOUS HEAT TREATMENTS ON EROSION RESISTANCE OF PLAIN CARBON STEEL
Joshua Salik and Donald H. Buckley Jan. 1981 10 p refs
(NASA-TP-1755; E-326) Avail: NTIS HC A02/MF A01 CSCL 11F

Erosion tests were conducted on 1045 steel samples which had been subjected to different heat treatments. The weight of material removed upon erosion with glass beads and crushed glass was measured. The data show that there is no correlation between hardness and erosion resistance. The erosion rate was strongly dependent on the shape of erodant particles, being an order of magnitude higher for erosion with crushed glass than with glass beads. Heat treatment had a profound effect on the erosion resistance when the erodant particles were glass beads but little or no effect when the particles were crushed glass. It is thus concluded that different mechanisms of material removal are involved with these two erodants. This conclusion is supported by the surface morphology of annealed 1045 steel samples which had been eroded by these two types of erodant particles. SEM micrographs of the eroded surfaces show that for erosion with glass beads it is deformation induced fracture of surface layers. Author

N81-16211*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECTS OF TRACE IMPURITIES IN COAL-DERIVED LIQUID FUELS ON DEPOSITION AND ACCELERATED HIGH TEMPERATURE CORROSION OF CAST SUPERALLOYS
Carl E. Lowell, Daniel J. Deadmore, Gilbert J. Santoro, and Fred J. Kohl 1981 19 p refs Presented at the 26th Ann. Intern. Gas Turbine Conf., Houston, Tex., 8-12 Mar. 1981; Sponsored by ASME
(Contract EF-77-A-01-2593)
(NASA-TM-81678; DOE/NASA/2593-22) Avail: NTIS HC A02/MF A01 CSCL 11F

The effects of trace metal impurities in coal-derived liquids on deposition, high temperature corrosion and fouling were examined. Alloys were burner rig tested from 800 to 1100 C and corrosion was evaluated as a function of potential impurities. Actual and doped fuel test were used to define an empirical life prediction equation. An evaluation of inhibitors to reduce or eliminate accelerated corrosion was made. Barium and strontium were found to limit attack. Intermittent application of the inhibitors or silicon additions were found to be effective techniques for controlling deposition without losing the inhibitor benefits. A computer program was used to predict the dew points and compositions of deposits. These predictions were confirmed in deposition test. The potential for such deposits to plug cooling holes of turbine airfoils was evaluated. Tests indicated that, while a potential problem exists, it strongly depended on minor impurity variations. M.G.

N81-16212*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROSTRUCTURE OF Al2O3 SCALES FORMED ON NiCrAl ALLOYS Ph.D. Thesis - Case Western Reserve Univ.
James Leo Smialek Jan. 1981 287 p refs
(NASA-TM-81676; E-664) Avail: NTIS HC A13/MF A01 CSCL 11F

The structure of transient scales formed on pure and Y or Zr-doped Ni-15Cr-13Al alloys oxidized for 0.1 hr at 1100 C was studied by the use of transmission electron microscopy. Crystallographically oriented scales were found on all three alloys, but especially for the Zr-doped NiCrAl. The oriented scales consisted of alpha-(Al,Cr)2O3, Ni(Al,Cr)2O4 and gamma-Al2O3. They were often found in intimate contact with each other such that the close-packed planes and directions of one oxide phase were aligned with those of another. The prominent structural features of the oriented scales were approximately equal to micrometer subgrains; voids, antiphase domain boundaries and aligned precipitates were also prevalent. Randomly oriented alpha-Al2O3 was also found and was the only oxide ever observed at the immediate oxide metal interface. These approximately 0.15 micrometer grains were populated by intragranular voids which decreased in size and number towards the oxide metal interface. A sequence of oxidation was proposed in which the composition of the growing scale changed from oriented oxides rich in Ni and Cr to oriented oxides rich in Al. At the same time the structure changed from cubic spinels to hexagonal corundums with apparent precipitates of one phase in the matrix of the other. Eventually randomly oriented pure alpha-Al2O3 formed as the stable oxide with an abrupt transition: there was no gradual loss of orientation, no gradual compositional change or no gradual decrease in precipitate density. R.C.T.

N81-16213# Rockwell International Corp., El Segundo, Calif. North American Div.
SUPERPLASTIC FORMED AND DIFFUSION BONDED TITANIUM LANDING GEAR COMPONENT FEASIBILITY STUDY Final Report, Mar. 1979 - Jul. 1980
Vernon E. Wilson Wright-Patterson AFB, Ohio AFFDL Jul. 1980 80 p
(Contract F33615-79-C-3401; AF Proj. 2402)
(AD-A092788; NA-80-333) Avail: NTIS HC A05/MF A01 CSCL 11/6

This report describes the development, fabrication and testing of a section of a main landing gear outer cylinder. The program demonstrated the feasibility of using the SuperPlastic Forming with concurrent Diffusion Bonding (SPF/DB) fabrication process to build a titanium cylindrical sandwich structure with a weight savings of 8-1/2 percent over the baseline steel cylinder. The development of joints, stop-off application and tooling is described. Structural analysis and subsequent structural testing proved that the cylindrical sandwich design is capable of meeting the loads that the outer cylinder of the landing gear would be subjected to in a current first line fighter aircraft. GRA

N81-16214# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

SCALE-UP OF A TITANIUM CARBONITRIDE COATING SYSTEM FOR TITANIUM ALLOYS Final Report, Sep. 1977 - Jun. 1979

Larry S. Sokol and Charles C. McComas Jul. 1980 57 p refs (Contract DAAG46-77-C-0057; DA Proj. 1T1-61310-D-071) (AD-A092245; PWA-FR-11897; AMMRC-TR-80-39) Avail: NTIS HC A04/MF A01 CSCL 11/6

The objectives of this program were to design, construct, and qualify a new, large reactor suitable for coating titanium alloy compressor components with titanium carbonitride (Ti-Cote C) on a production basis. Materials Technology Corporation (MTC), the sole source of Ti-Cote C, was responsible for the reactor scale-up and subsequent development effort. Microprobe and metallographic studies, erosion testing, the establishment of an S/N curve with coated airfoils, and a determination of the thermal shock resistance of coated airfoils were performed on parts coated in the new reactor. At the conclusion of the program, the scaled up reactor was still unable to deliver the consistent coating quality required for production. Coating coverage, adhesion, and thermal shock resistance were acceptable, but the erosion resistance varied greatly between reactor runs of identical parameters. The problem with the erosion resistance appeared to be related to the somewhat porous and granular microstructure of Ti-Cote C deposited in the new, hot wall reactor. No compositional variations were detected in the coating to explain the grainy structure and inconsistent erosion resistance. MTC performed a parametric study to improve coating reproducibility but it was not entirely successful. GRA

N81-16215# Rockwell International Science Center, Thousand Oaks, Calif.

LIFETIME PREDICTION OF ORGANIC COATING/METAL SYSTEM Annual Report, 1 Jul. 1979 - 30 Jun. 1980

Florian Mansfeld, J. Lumsden, S. Tsai, S. Jeanjaquet, and M. Kendig Aug. 1980 54 p refs
(Contract N00014-79-C-0437; NR Proj. 036-136)
(AD-A092382; SC5222.1AR) Avail: NTIS HC A04/MF A01 CSCL 11/3

The objective of this project is to develop a lifetime model which takes into account the corrosion susceptibility of metal substrates, the properties of organic coatings and the corrosivity of the environment. The results obtained during the first year include the characterization of steel surfaces which had been subjected to different pretreatment methods using surface chemistry analysis (AES, XPS, SEM), surface energetics analysis, and surface mapping. The deposition kinetics and surface morphology of zinc phosphate coatings on steel surfaces with different pretreatment have been studied with preliminary analysis using a.c. impedance techniques. These results provide a quantitative characterization of the substrate and provide input for a lifetime prediction model of polymer coated metal. GRA

N81-16216# Naval Postgraduate School, Monterey, Calif.

AN INVESTIGATION OF UNIPOLAR ARCING DAMAGE ON STAINLESS STEEL AND TITANIUM CARBIDE COATED SURFACES M.S. Thesis

Michael Thomas Keville Jun. 1980 93 p refs
(AD-A092307) Avail: NTIS HC A05/MF A01 CSCL 11/6

Unipolar arcing was studied using a new method of laser plasma production. The mechanism of unipolar arcing has been shown in the literature to be the most important source of wall erosion and plasma pollution. Arcing is of particular concern in Tokamak and other magnetically confined fusion devices. The experiment was conducted using a neodymium-glass laser in both normal pulse and Q-switched modes to generate a hot plasma. This plasma, generated from several different targets, was used to initiate arcing on the surface. From the experimental results, a model of the arcing process was proposed which extended those available in the literature. Further analysis using TiC film deposited by the Activated Reactive Evaporation technique indicated that such films showed promise in preventing or greatly minimizing unipolar arcing damage. GRA

N81-16217# Naval Research Lab., Washington, D. C.

EFFECT OF STRESS-STRAIN BEHAVIOR ON LOW-CYCLE FATIGUE OF ALPHA-BETA TITANIUM ALLOYS Interim Report

J. M. Krafft 21 Nov. 1980 30 p refs
(RR0230345)
(AD-A092473; NRL-MR-4406) Avail: NTIS HC A03/MF A01 CSCL 11/6

In earlier NRL work, Ti-6Al-4V in four levels of interstitial oxygen content and a single Ti-8Al-1Mo-1V alloy plate were heat treated to alter grain size and/or microstructural character; the effect on fatigue crack propagation rate was measured. In this work, small tensile specimens of these materials are subjected to slow strain-controlled cyclic deformation leading to rupture in the 5-500 cycle range. Indication of crack initiation as well as rupture life are compared relative to the plastic excursion strain. On this basis, effects of grain size and oxygen content are not clearly discriminated. Yet, some of the materials exhibit markedly superior performance. This improvement seems to be related to a characteristic evolution in the shape of the cyclic stress-strain curve. Here, relative to a full convex hysteresis loop of early cycles, the later cycles exhibit a reduced stress level, or cyclic softening, in the first half of the excursion, followed by a resurgence of strength to initial stress levels in the latter portion. The enhanced strain hardening rate enabling this terminal strength restoration is thought to stabilize the deformation, reducing the amount of stress-relaxation-induced tensile strain. Taking such strain as an increment of damage in a cumulative cyclic creep strain criterion provides a correlation between the evolving shape of the cyclic stress-strain curve and the low cycle fatigue endurance. Results indicate the absolute increase in the terminal plastic strain hardening rate to be a constant of a material, independent of the cyclic strain excursion. GRA

N81-16218# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.

AN INVESTIGATION OF THE STRUCTURE AND MECHANICAL PROPERTIES OF HIGH TEMPERATURE GLASSY AND MICROCRYSTALLINE ALLOYS Final Report, 1 May 1979 - 15 Jul. 1980

N. J. Grant, J. B. Vandersande, C. Ashdown, and L. Collins 27 Oct. 1980 30 p refs
(Contract DAAG29-79-C-0077)
(AD-A092251; ARO-16219.1-MS) Avail: NTIS HC A03/MF A01 CSCL 11/2

This research had two aims: (a) development and characterization of high Tg (or Tx) glassy alloys, and, (b) identification and development of glassy Fe, Ni and Co base alloys which are capable of undergoing crystallization to a ductile, superfine grain size (less than about 0.1 micrometer), hot workable alloy product. In the first instance the $Ni_{60}Nb_{40}$ and $Ni_{85}Nb_{15}$ composition ranges were studied for glass formation, crystallization and properties. Alloying studies were undertaken to increase Tg(Tx) and to strengthen and stabilize the glassy state. In the second instance, compositions and glass forming tendencies were studied whereby the lowest possible metalloid content could be achieved while still producing a glass. For example, the classical $Fe_{80}B_{20}$ composition can be kept in the glassy state during melt spinning for compositions as low as 12-14 at. pct. boron. GRA

N81-16219# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.

OBSERVATIONS OF THE EFFECTS OF TEMPERATURE AND CRYSTALLOGRAPHIC ORIENTATION ON SURFACE SEGREGATION IN AN Fe-Si-Sn-C ALLOY Interim Report

Xong-Xin Zhou, Shin-Cheng Fu, and C. J. McMahon, Jr. 17 Oct. 1980 25 p refs Submitted for publication
(Contract N00014-79-C-0991)
(AD-A092169; TR-2) Avail: NTIS HC A02/MF A01 CSCL 11/6

Auger electron spectroscopy was used to study segregation of Group 4B solutes to the surfaces of individual grains of a polycrystalline Fe-3.1 pct Si-0.06 pct Sn-0.004 pct C alloy heated in UHV. As the temperature was increased C, Si and finally Sn segregate in that order, consistent with their diffusivities in Fe, each succeeding element expelling the preceding from the surface. The interactions between C and Si and between Si and Sn appear to be strongly repulsive, while the interaction between C and Sn appears weak; this is discussed in terms of a size effect. The segregation behavior of each element depends on the

crystallographic orientation of the surface; C and Sn seem to follow similar patterns, while Si behaves somewhat differently.
GRA

N81-16220# Dayton Univ., Ohio.
MECHANICAL PROPERTY EVALUATION OF ALUMINUM ALLOY 7010-T73651 Interim Technical Report, Nov. 1978 - Mar. 1980
Russell R. Cervay Wright-Patterson AFB, Ohio AFFDL Jul. 1980 29 p refs
(Contract F33615-78-C-5002; AF Proj. 2421)
(AD-A091945; UDR-TR-80-29; AFWAL-TR-80-4094) Avail: NTIS HC A03/MF A01 CSCL 11/6

The alloy 7010 has been represented by its manufacturer as being a high strength/high toughness, and stress corrosion cracking resistant aluminum alloy. Like the 7050 alloy, it is a high purity aluminum alloy using Zr as the grain refiner alloying element rather than Cr. Also, the Cu alloying content is higher than normal for most 7000 series aluminum alloys. Tensile test results indicate the average room temperature tensile strength was 73 KSI (502 MPa) and the yield strength was 64 KSI (440 MPa) for longitudinal grain orientation test specimens. For the same test conditions, the ductility as indicated by an elongation of 13 percent (1 in., 25.4 mm G.L.) was directly comparable to alloy 7175-T73 in the thick plate product form. The average fracture toughness at 72F (22C) for a (L-t) orientation test specimen was 37 KSI sq. rt. in. (40.6 MPa sq. rt. in.) which is approximately equal to alloy 7050-T73651. The material was not found to be corrosion cracking sensitive; the room temperature threshold for stress corrosion cracking in a 3.5% Wt. NaCl solution was determined to be in excess of 70 percent of the room temperature fracture toughness. The materials room temperature constant amplitude fatigue crack growth rate was equivalent to the more cracking resistant 7000 series alloys (7475 and 7050). An increase in the test temperature from 72F (22C) to 250F (121C) caused an increase in excess of 200 percent in the fatigue crack growth rate. A further increase in test temperature to 350 F (176C) caused a small increase in the crack growth rate beyond that existing at 250F (121C).
GRA

N81-16221# Illinois Univ. at Urbana-Champaign.
STRESS-CORROSION CRACKING OF HIGH-STRENGTH ALUMINUM ALLOYS Final Technical Report, Jan. 1977 - 30 Jun. 1980
E. N. Pugh 18 Sep. 1980 13 p refs
(Grant AF-AFOSR-3175-77; AF Proj. 2306)
(AD-A092186; AFOSR-80-1120TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

A study has been made of the mechanism of hydrogen embrittlement (HE) in Al-Zn-Mg alloys and of the role of hydrogen in the intergranular stress-corrosion cracking (I-SCC) of these alloys. Up to 300 ppm (1 at pct) hydrogen was introduced into a high-purity Al-5.6 Zn-2.6Mg alloy, either by room temperature polishing with aqueous slurries of alumina particles or by exposure to water-vapor-saturated air (WVSA) at 70 C and subsequent tensile tests (stress rate approx 0.0001/s) in inert environments caused brittle intergranular fracture. Embrittlement was found to be reversible, the tensile properties being completely restored when the hydrogen was outgassed. At low hydrogen contents, embrittlement was suppressed by the use of high strain rates (approx 0.01/s), but could not be suppressed by impact testing at large hydrogen concentrations. The intergranular fracture surfaces were observed to be associated with a fragmented layer and electron-diffraction experiments indicated that it corresponded to a hexagonal aluminum hydride, Al H3, with a - 2.90 A and c - 4.55 A. This hydride, considered to be stress-induced, was unstable in laboratory air, slowly decomposing to FCC Al. It is concluded that internal HE in this alloy occurs by repeated cycles of the formation and rupture of this brittle hydrogen.
GRA

N81-16222# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.
CALCULATION OF THE OXIDE GROWTH RATE OF 2-1/4 CR-1Mo STEEL IN AIR AND THE SUBSEQUENT MEASUREMENT OF THE STRAIN REQUIRED TO CRACK THE OXIDE M.S. Thesis
Robert Lawrence Langdon Sep. 1980 69 p refs
(AD-A092302) Avail: NTIS HC A04/MF A01 CSCL 11/6

This study examined the oxide growth rate of 2-1/4 Cr - 1 Mo steel in air under isothermal growth conditions. Two oxidizing temperatures were used, 403 C and 499 C, for five specimens each with oxidizing times varying from 6 hours to 700 hours. Average oxide growth rate as a function of time and temperature was found to be rate = 0.0021 exp -12950/RT whereas maximum oxide growth rate corresponds to rate = 0.0045 exp -13520/RT. These values were found to be in general agreement with the limited data available in the literature. The second part of the experiment related to the measurement of the strain required to crack the oxide. Discrete surface strains were imparted to oxidized specimens via a four-point-bend straining apparatus. The strained specimens were optically scanned for cracks with a stereoscope microscope capable of 70X magnification. A process of crack decoration was employed to enhance crack visibility. Because of certain equipment limitations, however, only an upper limit of strain tolerance could be determined. Methods of improving strain tolerance measurements are discussed.
GRA

N81-16223# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Materials Integrity Branch.
EFFECTS OF PURITY LEVEL ON THE MECHANICAL PROPERTIES OF 7000 SERIES ALUMINUMS Final Report, Jul. 1976 - Mar. 1977
G. J. Petrak Oct. 1980 70 p ref
(AF Proj. 2418)
(AD-A092592; AFWAL-TR-80-4079) Avail: NTIS HC A04/MF A01 CSCL 11/6

The effect of purity level on the mechanical properties of high strength aluminum alloys was studied. Seven extrusions, representing three alloys, were tested for their mechanical properties. Three extrusions were 7049-T73511, one was 7050-T73511, and the remaining were 7075-T73511. The 7049 and 7075 extrusions were manufactured in three purity levels, indexed to iron and silicon. When going from high purity to low purity, the following observations were made; the tensile strength dropped slightly, the fracture toughness fell dramatically and fatigue and fatigue crack growth rate properties were not affected in a systematic manner. Stress corrosion cracking tests showed there does not appear to be a corrosion problem for any of the materials of purity levels.
GRA

N81-16224# Colorado School of Mines, Golden. Dept. of Metallurgical Engineering.
TEMPERING AND FRACTURE BEHAVIOR OF HIGH CARBON MARTENSITE Final Report, 15 Jul. 1977 - 20 Aug. 1980
George Krauss 15 Oct. 1980 8 p refs
(Contract DAAG29-79-C-0141; Grant DAAG29-77-G-0180)
(AD-A092654; ARO-14972.8-MS) Avail: NTIS HC A02/MF A01 CSCL 11/6

The effects of austenitizing and tempering on the fracture behavior and toughness of high carbon steels were investigated on martensitic specimens of AISI 52100 steel. Two levels of phosphorus content, 0.023 and 0.009 P, were evaluated. Specimens austenitized below Acm fractured primarily in a transgranular mode and showed slightly improved toughness, compared to the as-quenched condition, after tempering at 200 C. Higher temperature tempering resulted in reduced toughness before a substantial increase in toughness developed after tempering at 400 C and above. The effect of P was most pronounced in specimens tempered above 400 C with the higher P specimens showing significantly lower toughness. Specimens austenitized above Acm failed primarily in an intergranular mode even in the as-quenched and low temperature-tempered specimens. Auger electron spectroscopy showed that the intergranular fracture was associated with thin carbide films that had apparently formed during quenching. Proeutectoid cementite grain-boundry allotriomorphy formation was stimulated by high P content. The prior austenite grain boundary carbide formation may not only cause the low toughness fracture at quenched and tempered specimens but may also be associated with the quench cracking frequently observed in high carbon steels. GRA

N81-16225# Rensselaer Polytechnic Inst., Troy, N. Y.
THE INFLUENCE OF COHERENCY STRAIN ON THE ELEVATED TEMPERATURE TENSILE BEHAVIOR OF Ni15Cr-Al-Ti-Mo ALLOYS
D. A. Grose (IBM Data Systems Div., Hopewell Junction, N.Y.) and G. S. Ansell Dec. 1980 71 p refs Submitted for publication
(Contract N00014-76-C-0458; NR Proj. 031-689)
(AD-A092781; TR-11) Avail: NTIS HC A04/MF A01 CSCL 11/6

The effect of coherency strain on elevated temperature tensile strength was examined in a model, two-phase gamma prime-strengthened Ni-15Cr-Al-Ti-Mo alloy series. The temperature dependence of coherency strain as represented by the gamma-gamma prime mismatch was determined over the temperature range 25 C to 300 C. The flow stress increment delta sigma sub y prime due to precipitation of gamma prime was found to correlate well to the magnitude of the gamma-gamma prime mismatch over the same temperautre interval. The correlation was strongest for high misfit alloys regardless of the Antiphase Boundary Energy (APBE). The predominance of by-pass type dislocation-particle interactions in high coherency alloys confirms that strengthening is primarily due to coherency strains. Conversely, alloys with low misfit exhibit two distinct particle shear mechanisms believed to be dependent upon the relative APBE and matrix stacking falt energy of the alloy. GRA

N81-16226# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
ELIMINATION OF IMPURITY-INDUCED EMBRITTLEMENT IN STEEL. PART 2: HIGH-TEMPERATURE CRACKING; STRESS RELIEF AND CREEP CRACKING Interim Report
D. P. Pope, K. A. Abiko, R. L. Bodnar, D. S. Wilkinson, C. J McMahon, Jr., R. Dobbs, and D. Gentner Sep. 1980 79 p refs
(EPRI Proj. 559)
(EPRI-NP-1501-Pt-2) Avail: NTIS HC A05/MF A01

The effects of compositional and microstructural parameters on the temper embrittlement susceptibility of Ni-Cr and Cr-MO type steels are investigated. Results show the three principal variables affecting the embrittlement behavior of the steels to be the grain boundary composition, grain size and the hardness. Unified embrittlement equations are developed relating the combined effect of the three variables to the transition temperature of the steel. For Cr-MO type steels not containing any nickel, phosphorous is found to be the major impurity responsible for temper embrittlement. Manganese and silicon are also found to be detrimental due to their interactive effects with phosphorous. The temperature of the transformation product (bainite vs. martensite) is not found to significantly influence the embrittlement susceptibility of the Cr-MO steels. Auger electron spectroscopic analysis of the surface layers of samples of the various steels heated to elevated temperatures was also completed. Results show that this technique can be successfully applied for determining the kinetics of segregation processes in complex steels and to understand the effects of minor alloying elements on the segregation behavior of impurity elements. M.G.

N81-16227# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
ENVIRONMENTAL REACTIONS AND THEIR EFFECTS ON MECHANICAL BEHAVIOR OF METALLIC MATERIALS Technical Progress Report
R. Gibala, J. Ratka, J. Talia, and S. Wu 31 Oct. 1980 41 p refs Proposed for presentation at the United States-Japan Seminar on Mech. Properties of BCC Metals, Honolulu, 23-27 Mar. 1981
(Contract DE-AC02-79ER-10359)
(COO-1676-50) Avail: NTIS HC A03/MF A01

Projects pertaining to implantation softening of niobium, the crack path in hydrogen embrittlement of 4340 steel, and hydrogen embrittlement and stress corrosion cracking are described. Other areas discussed include solution hardening and softening of niobium by interstitial solutes and solution hardening and softening in oxide coated niobium and niobium alloys. E.D.K.

N81-16228# Pennsylvania Univ., Philadelphia.
KINETICS OF THE DESULFURIZATION OF MOLTEN IRON Progress Report, 1 Mar. - 1 Oct. 1980
D. R. Gaskell Oct. 1980 5 p
(Contract EM-78-S-02-4725)
(COO-4725-5) Avail: NTIS HC A02/MF A01

The rate of desulfurization of liquid iron by liquid CaO-saturated CaO-FeO was measured at 1600 C. The initial oxygen content of the iron is that which is in equilibrium with the slag at 1600 C. The rate of desulfurization is controlled by diffusion of sulfur in the metal. The observed initial stage of rapid desulfurization is due to interfacial tension induced local turbulence at the interface. R.C.T.

N81-16229# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
A STUDY OF FUNDAMENTAL REACTION PATHWAYS FOR TRANSITION METAL ALKYL COMPLEXES. 1: THE REACTION OF A NICKEL METHYL COMPLEX WITH ALKYNES. 2: THE MECHANISM OF ALDEHYDE FORMATION IN THE REACTION OF A MOLYBDENUM HYDRIDE WITH MOLYBDENUM ALKYLS Ph.D. Thesis - California Inst. of Technology, Pasadena
John Mitchell Huggins 1981 206 p refs
(Contract W-7405-eng-48; Grant NIH-GM-12459)
(LBL-11697) Avail: NTIS HC A10/MF A01

The rapid reaction under mild conditions of internal or terminal alkynes with methyl(acetylacetonato) (triphenylphosphine) nickel (1) in either aromatic or ether solvents was investigated. In all cases vinylnickel products are formed by insertion of the alkyne into the nickel methyl bond. These complexes may be converted into a variety of organic products (e.g., alkenes, esters, vinyl halides) by treatment with appropriate reagents. Unsymmetrical alkynes give selectively the one regioisomer with the sterically largest substituent next to the nickel atom. An X-ray diffraction study of the reaction of 1 with diphenylacetylene was carried out in order to investigate the stereochemistry of the initial insertion. This showed that the vinylnickel complex formed by overall trans insertion was the product of the reaction. R.C.T.

N81-16230# California Univ., Livermore. Lawrence Livermore Lab.
THE EFFECT OF STRAIN ON THE MARTENSITIC PHASE TRANSITION IN SUPERCONDUCTING Nb3Sn
R. W. Hoard, R. M. Scanlan, G. S. Smith, and C. L. Farrell 22 Sep. 1980 5 p refs Presented at Proc. of the 1980 Appl. Superconductivity Conf., Santa Fe, N. Mex., 29 Sep. - 2 Oct. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84211; CONF-800980-1) Avail: NTIS HC A02/MF A01

The connection between the cubic-to-tetragonal martensitic phase transformation and the phenomenon of superconductivity in A15 compounds was investigated. The degradation of the critical parameters, such as T sub c, H sub c2 and J sub c with mechanical straining was emphasized. Low temperature X-ray diffraction experiments was performed on Nb3Sn ribbons (with the bronze layers etched off) mounted on copper and indium sample stages. The cryostat used was unique in that it had a vacuum mechanical insert which allows the superconductor to be placed under both compressive and tensile strains while at low temperatures. Results indicate that the martensitic phase transition temperature, T sub m, increases with compressive strains. R.C.T.

N81-16231# Sandia Labs., Albuquerque, N. Mex.
PULSED LASER ANNEALING OF ALUMINUM
W. R. Wampler, D. N. Follstaedt, and P. S. Peercy 1980 8 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2610C; CONF-801124-23) Avail: NTIS HC A02/MF A01

Pulsed ruby laser irradiation of unimplanted single crystal and implanted polycrystalline Al was studied with ion beam analysis and TEM. The results show that Al is melted to a depth of about 0.9 micrometers with a 4.2 J/sq cm, 15 nsec pulse, and that vacancies are quenched into Al during resolidification. Diffusion of Zn in liquid Al is observed, and a melt time of about 65 nsec is estimated for a 3.8 J/sq cm, 30 nsec pulse. The observations are in reasonable agreement with calculations of sample temperature and melt times. Author

N81-16232# Sandia Corp., Livermore, Calif. Computer Applications Div.
QUANTITATIVE METALLURGY USING IMAGE PROCESSING TECHNIQUES
H. D. Jones Oct. 1980 16 p Sponsored by DOE
(SAND-80-8229) Avail: NTIS HC A02/MF A01

Image processing techniques were applied to the analysis of uranium niobium alloys. From each of several radiographs of samples of the alloy, numerical values of the concentration of niobium throughout the sample were calculated, correcting for variations in the sample thickness and for the film response characteristics. The values are as accurate as can be expected given the uncertainties in the measurements of the sample thickness. The methods used to generate the images and how the information that the images provide is used are discussed. The problems encountered in calibrating the images to the desired accuracy are reviewed. E.D.K.

N81-16233# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EFFECT OF MICROSTRUCTURE ON THE SUSCEPTIBILITY TO HYDROGEN ATTACK
R. O. Williams Nov. 1980 11 p
(Contract W-7405-eng-26)
(ORNL/TM-7554) Avail: NTIS HC A02/MF A01

The departure from internal equilibrium in low alloy steels is associated with a variable carbon activity. This is perceived to be of considerable importance in the susceptibility of such steels to hydrogen attack. A thermodynamic description of the phases in coexistence is presented. The carbon activity was calculated as a function of the degree of partitioning of the alloy additions to the carbide phases. The kinetics of the partitioning were calculated. T.M.

N81-16234# United Nuclear Industries, Inc., Richland, Wash.
SELECTION OF A NON-COBALT ALLOY FOR SLIDING-WEAR SERVICE IN A NUCLEAR VALUE
D. J. Trimble and T. A. Galioto 31 Jul. 1980 29 p refs
(Contract DE-AC06-76RL-01857)
(UNI-SA-73; CONF-8003105-1) Avail: NTIS HC A03/MF A01

A number of candidate materials were evaluated as a possible alternative materials couple for a specific nuclear check valve application. Nickel alloys, cobalt alloys, stainless steels, and diffusion coatings were among the materials tested. An in service test was conducted in which two selected alternate couples were subjected to one year of actual reactor operation. R.C.T.

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N81-16235 Lehigh Univ., Bethlehem, Pa.
CHARACTERIZATION OF CORROSION RESISTANT ORGANIC COATINGS USING ELECTRIC IMPEDANCE MEASUREMENTS Ph.D. Thesis
John Vellom Standish 1980 202 p
Avail: Univ. Microfilms Order No. 8102518

Electric impedance measurements were used to characterize organic coatings and free films. A phase sensitive detector known as a lock-in amplifier was used to make impedance measurements. The coatings used were primarily unpigmented polyamide cured epoxy resins. Impedance values of coatings were measured as a function of exposure time to an electrolyte, concentration of electrolyte, frequency, voltage, physical condition of a coating, position of a probe electrode on the coating surface, and temperature. Some samples were evaluated by microscopy differential scanning calorimetry and dynamic mechanical testing. The impedance of epoxy/polyamide coatings decreases rapidly during the first 15 hours of exposure to 3 percent NaCl. The impedance of epoxy coatings cured with a diamine changed at a slower rate during exposure to 3 percent NaCl. The difference in rates was attributed to chemical and morphological differences in the coatings. Dissert. Abstr.

N81-16236 Massachusetts Univ., Amherst.
CHARACTERIZATION, RHEOLOGY AND SHEAR INDUCED REACTIONS OF POLY(VINYL ACETATE) Ph.D. Thesis
Surendrakumar Hukamchand Agarwal 1980 139 p
Avail: Univ. Microfilms Order No. 8101295

Poly(vinyl acetate)(PVAc) was characterized in terms of its molecular weight, molecular weight distribution and long chain branching. This was done by gel permeation chromatography on line with low angle laser light scattering photometry. The effect of shear on long chain branching of PVAc was also investigated. On shearing, 80% of the decrease in molecular weight was found to occur due to scission of long chain branches through the acetate group. The rheological properties of PVAc were measured in benzyl alcohol and diethyl phthalate over a broad range of shear rates and concentrations. Steady shear viscosity, first normal stress difference and dynamic viscoelastic data were obtained by a Rheometric RMS 7200 Mechanical Spectrometer. The high shear data (up to 0.000001/sec) were obtained from a high shear concentric cylinder viscometer. The viscosity shear data could be superimposed on the Graessley master curve (derived for M bar w/M bar m = 1.65 for PVAc) at lower shear rates for all concentrations but not at higher shear rates. The steady flow and dynamic oscillatory behavior were intercorrelated by a constant shift factor. Dissert. Abstr.

N81-16237 North Carolina State Univ. at Raleigh.
ORIENTATION OF POLYETHYLENE GLYCOL CRYSTALLIZED ON A NYLON 6,6 SUBSTRATE Ph.D. Thesis
Howard Wayne Swofford 1980 147 p
Avail: Univ. Microfilms Order No. 8100827

The orientation of polyethylene glycol in nylon 6,6/PEG fiber blends and on oriented nylon 6,6 films was studied using X-ray diffraction. Calculation of the potential energy due to van der Waals forces between a model PEG chain and model nucleus and a nylon, 6,6 (010) plane were carried out in order to predict the most probable orientation of the PEG on nylon 6,6. The orientation of the PEG in nylon 6,6/PEG fibers was confirmed by X-ray diffraction to be with the PEG b-axis parallel to the nylon 6,6 c-axis and the PEG c-axis perpendicular to the nylon 6,6 c-axis. The calculations of the minimum potential energy predicted that the orientation of the PEG c-axis would be parallel to the a-axis for both a single chain and a four chain nucleus. Crystallixation of PEG from an aqueous solution on the surface of an oriented nylon 6,6 film yielded an unoriented overgrowth. Dissert. Abstr.

N81-16238*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD OF BONDING PLASTICIZED ELASTOMER TO METAL AND ARTICLE PRODUCED THEREBY Patent Application
William T. White, Johnny M. Clemons, and Frank E. Ledbetter, inventors (to NASA) Filed 19 Dec. 1980 9 p
(NASA-Case-MFS-25181-1; US-Patent-Appl-SN-218585) Avail: NTIS HC A02/MF A01 CSCL 11A

A plasticized elastomer is securely bonded to a metal surface by interposing between the adhesive coated metal surface and the elastomer a sheet of material obtained by combining adhesive with a portion of the elastomer that has been treated to remove plasticizers. The assembly is then heated in a mold under pressure. The sheet material is made up by dissolving a portion of the plasticized elastomer in an organic solvent, casting the solution, exposing it to a vacuum to remove the solvent and plasticizers, dissolving the deplasticized material in liquid adhesive and casting and drying the resulting liquid. NASA

N81-16239# Rockwell International Science Center, Thousand Oaks, Calif. Structural Ceramics Group.
RESEARCH OF MICROSTRUCTURALLY DEVELOPED TOUGHENING MECHANISMS IN CERAMICS. STRESS INDUCED TRANSFORMATION TOUGHENING. PART 1: SIZE EFFECTS ASSOCIATED WITH CONSTRAINED PHASE TRANSFORMATION THERMODYNAMICS
F. F. Lange Oct. 1980 29 p refs
(Contract N00014-77-C-0441)
(AD-A092253; SC5117.8TR) Avail: NTIS HC A03/MF A01 CSCL 11/2

The thermodynamics of the constrained phase transformation

is presented with particular reference to size effects introduced by surface phenomena concurrent with the transformation, e.g., the formation of solid-solid surfaces (twins, etc.) and solid-vapor surfaces (e.g., microcracks). It is shown that these surface phenomena not only introduce a size-dependent energy term into the total free energy change, but also reduce the strain energy associated with the transformation, which can result in a transformation at a temperature where the chemical free energy change is less than the unrelieved strain energy associated with the constrained transformation. The results of this analysis lead to a phase diagram representation that includes the size of the transforming inclusion. This diagram can be used to define the critical inclusion size required to prevent the transformation and/or to obtain the transformation, but avoid one or more of the concurrent surface phenomena. GRA

N81-16240*# Lake Shore Cryotronics, Inc., Westerville, Ohio.
EVALUATION OF HIGH SPECIFIC-HEAT CERAMIC FOR REGENERATOR USE AT TEMPERATURES BETWEEN 2-30 K Final Report
W. N. Lawless Dec. 1979 39 p refs Prepared for JPL (Contracts NAS7-100; JPL-955446)
(NASA-CR-163888; JPL-9950-458) Avail: NTIS HC A03/MF A01 CSCL 11B

Specific heat, thermal conductivity (both in the range 2-30 K), and microhardness data were measured on the ceramics labelled LS-8, LS-8A, and LS-8A doped with CsI, SnCl2, and AgCl. A work hardened sample of LS-8A was also studied in an effort to determine the feasibility of using these types of LS-8 materials to replace Pb spheres in the regenerator of the JPL cryocooler. The LS-8A materials are all more than an order of magnitude harder than Pb, and the dopants do not significantly improve the hardness. However, the SnCl2 dopant has a remarkable effect in improving the specific heat and thermal conductivity of LS-8A. The SnCl2 doping level which maximized the regenerator enthalpy change in going from an unloaded to a loaded condition was found to be 0.2 percent SnCl2 in LS-8A. It was also found that the enthalpy change for a regenerator employing the LS-8A material is more than three times larger than for the Pb spheres case. The use of rods, rather than spheres, of optimally doped LS-8A in regenerators is discussed. A.R.H.

N81-16241*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group.
ANTI-REFLECTION COATINGS ON LARGE AREA GLASS SHEETS Final Report
E. Pastirik Sep. 1980 54 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-955339)
(NASA-CR-163879; Motorola-2366/4; DOE/JPL-955339-80/4; JPL-9950-455) Avail: NTIS HC A04/MF A01 CSCL 11C

Antireflective coatings which may be suitable for use on the covers of photovoltaic solar modules can be easily produced by a dipping process. The coatings are applied to glass by drawing sheets of glass vertically out of dilute aqueous sodium silicate solutions at a constant speed, allowing the adherent liquid film to dry, then exposing the dried film to concentrated sulfuric acid, followed by a water rinse and dry. The process produces coatings of good optical performance (96.7 percent peak transmission at 0.540 mu M wavelength) combined with excellent stain and soil resistance, and good resistance to abrasion. The process is reproduceable and easily controlled. Author

N81-16242# European Space Agency, Paris (France).
THE DIFFUSION OF WATER VAPOR IN HUMID AIR INTO THE BONDLINES OF ADHESIVELY BONDED METAL JOINTS
Walter Althof Jun. 1980 53 p refs Transl. into ENGLISH of "Die Diffusion des Wasserdampfes der Feuchten Luft in die Klebschichten von Metallklebungen", DFVLR-FB-79-06, Brunswick, Feb. 1979 79 p Original report in GERMAN previously announced as X80-75013 Original German report available from DFVLR, Cologne DM 15,40
(ESA-TT-619; DFVLR-FB-79-06) Avail: NTIS HC A04/MF A01

The moisture content of five aircraft structural adhesives as a function of time and environmental conditions was determined by weighing bulk adhesive material specimens and bonded-joint specimens before and after exposure to six test environments. The diffusion coefficient was calculated according to Fick's law. The functional relationship between the moisture content of the adhesive at saturation and the atmospheric humidity was calculated. Formulae are given for calculating the moisture distribution in a glueline; control tests confirmed that the formulae are applicable, provided the adhesive remains unchanged by the environment. Author

N81-16243# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
MOLECULAR FRACTION BEHAVIOR IN ORIENTED POLYMERS Final Report, 1 Sep. 1976 - 31 Aug. 1979
Rakesh K. Popli and David K. Roylance Jun. 1980 136 p refs
(Contract DAAG29-76-C-0044)
(AD-A092241; ARO-13630.3-MSX) Avail: NTIS HC A07/MF A01 CSCL 11/9

Fracture in polymers of fibrous morphology is accompanied by covalent bond scission. Gel permeation chromatography (GPC) was used to monitor the changes in molecular weight distribution upon fracture in nylon 6 fibers. The bond rupture of 2.3 x 10 to the 18th power per cu cm measured from GPC is approximately five times the number of free radicals observed on fracture using electron spin resonance (ESR). GPC results showed that the high molecular weight component of the molecular weight distribution ruptures preferentially. Fourier transform infra-red spectroscopy (FTIS) observation of virgin, fractured, ground, and irradiated nylon 6 fiber specimens provided additional evidence supporting the results of GPC and ESR. A quantitative measure of the bond rupture could not be obtained from FTIS measurements. Some calculations for the structure of the fibrous morphology were performed: (1) calculation for the number of the molecules per gram. This was found to be approximately 1 x 10 to the 20th power per gram in nylon 6 fibers. (2) calculation for the contribution of various amorphous components like cilia, chain loops (folds), chain ends, and tie chains. (3) a model for the distribution of the tie chain lengths. The experimental results of GPC and some of the calculations above were used to review the morphology and the fracture behavior of the fibrous structure. A new mechanism for the formation of submicroscopic cracks in stressed fibers is proposed. GRA

N81-16244# Naval Research Lab., Washington, D. C. Inorganic and Electrochemistry Branch.
A NEW METHOD AND COMPOSITION FOR CLEANING METAL SURFACES Interim Report
D. L. Venezky and R. Panayappan 10 Nov. 1980 14 p refs (RR0130645)
(AD-A092130; NRL-MR-4404) Avail: NTIS HC A02/MF A01 CSCL 11/9

A new method and composition for cleaning metal surfaces has been developed. The mixture consisting of a water soluble polymer, preferably polyvinylpyrrolidone (PVP), and a chelating agent can be applied to a rusty metal surface as a thick paste. The outer surface of the paste gradually hardens into an encapsulating film entrapping the cleaning agents inside and in contact with the rust until the surface is clean. After cleaning, the tape-like coating can be easily peeled from the cleaned surface and disposed of as a solid waste. Advantages of the new system include: economical and environmentally safe ingredients; and the ability to clean irregular surfaces and overhead objects found on ships, i.e., high-temperature valves, pipes and the like, without sandblasting or washing procedures. GRA

N81-16245# Columbia Univ., New York. Dept. of Chemistry.
REACTIVITIES OF METAL-CARBENES TOWARD ALKENES AND ALKYNES Technical Report, 1 Aug. 1979 - 20 Nov. 1980
Thomas J. Katz, Edward B. Savage, Steven J. Lee, and Mridula Nair 20 Nov. 1980 17 p refs Submitted for publication
(Contract N00014-79-C-0683; Grant NSF CHE-77-22726; NR Proj. 356-726)
(AD-A092736; TR-2) Avail: NTIS HC A02/MF A01 CSCL 07/3

Stabilized metal-carbenes like the P's in eqs 2 and 3 are

very much more reactive toward phenylacetylene than toward cyclopentene (by a factor of 119-170) or cyclooctene (by a factor = 10 to the 4th power). The result is strange but accords with 1 (also a stabilized metal-carbene) reacting much faster with acetylenes than with alkenes. In contrast, unstabilized metal-carbenes like the C's in eqs 4 and 5 are more reactive toward the cycloalkenes (cyclopenetene 6-8 fold, cyclooctene ca. = 24 fold) than toward the acetylene. These figures were derived by analyzing the kinetics of eqs 1-5, the simplest theory accounting for why phenylacetylene induces metatheses and why the yields and molecular weights of the polypentenamer formed by combining (phenylmethoxycarbene) pentacarbonyltungsten with phenylacetylene and cyclopentene decrease as the phenylacetylene concentration is increased. Evidence for the theory is found in gel permeation chromatograms of the polymers showing that polyalkenamer and polyacetylene units are linked. GRA

N81-16246# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.

A MODIFIED TECHNIQUE FOR MEASUREMENT OF ORIENTATION FROM POLYMER SURFACES BY ATTENUATED TOTAL REFLECTION IR DICHROISM

C. S. P. Sung Nov. 1980 24 p refs Submitted for publication

(Contract N00014-78-C-0676; NR Proj. 356-699)

(AD-A092662; TR-3) Avail: NTIS HC A02/MF A01 CSCL 11/9

For a sensitive measurement of surface molecular orientation by attenuated total reflection IR dichroism, a modified sample holder was developed utilizing a symmetrical, double-edged internal reflection cyrstal. This modified sample holder allows the sample to be rotated without the disassembling and reassembling operations which change the contact area between the polymer and the ATR crystal. Therefore, correction of the reflectivities to an internal standard absorption band which is insensitive to orientation is not necessary in this modified apparatus. This was tested on two types of polypropylene. Results with uniaxially drawn polypropylene show that the surface orientation is similar to the bulk, as expected. On the other hand, the orientation as measured by this technique was greater on the surface than in the core of an injection molded polypropylene plate, a tendency confirmed by birefringence. This technique can be used for estimating bulk orientation of a thick sample without sectioning when the surface has similar orientation to the bulk. In cases where the surface differs significantly in orientation from the bulk, our technique should provide a more surface-sensitive estimation than birefringence, since the surface probed is much thinner (only about 1 micron) in this technique. GRA

N81-16247# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.

THE INFLUENCE OF ALLOY COMPOSITION AND THERMO-MECHANICAL PROCESSING PROCEDURE ON MICROSTRUCTURE AND MECHANICAL PROPERTIES OF HIGH-MAGNESIUM ALLOYS M.S. Thesis

Ralph Brian Johnson Jun. 1980 90 p refs

(AD-A092564) Avail: NTIS HC A05/MF A01 CSCL 11/6

The purpose of this research was the development of a thermomechanical procedure to process aluminum-magnesium alloys and testing effects of alloying additions on these alloys. Magnesium contents of eight and ten weight percent and the alloying effects of copper and manganese were studied. Microstructures and mechanical properties at six warm rolling temperatures located above and below the solvus line of these alloys were examined. Ultimate tensile strengths in excess of 680 MPa (99 KSI) were obtained. Microstructural evidence indicated that the precipitation of the 'beta' intermetallic phase was one of the most important mechanisms in controlling the strength of the alloy. Furthermore, precipitation is so rapid at higher temperatures that it becomes the strongest force within the microstructure and its presence prevents any possible recrystallization of the alloy. However, when the temperature exceeds the solvus temperature for the alloy, recrystallization does occur with large losses in both yield and ultimate tensile strength. GRA

N81-16248# New York Univ., N. Y. Dept. of Physics.

THEORETICAL INVESTIGATION OF ATOMIC STRUCTURE AND SCATTERING PROCESSES Summary Questionnaire, Mar. 1980 - Feb. 1981

Larry Spruch and Leonard Rosenberg Nov. 1980 7 p refs

(Contract N00014-76-C-0317; NR Proj. 393-005)

(AD-A092754) Avail: NTIS HC A02/MF A01 CSCL 07/4

One area explored is the use of intense laser beams in interaction with atomic systems; the interaction of the projectile and target in a scattering problem with the laser beam is accounted for. We have further explored the applicability of variational methods in general scattering processes. GRA

N81-16249# California Univ., Livermore. Lawrence Livermore Lab.

DEVELOPMENT OF ALTERNATE SILICONE POTTING COMPOUNDS. VOLUME 7: DEVELOPMENT OF SECONDARY ALTERNATIVES FOR DOW CORNING'S AEROSPACE SEALANT, DC93-120

William E. Cady and Albert T. Buckner 19 Aug. 1980 32 p refs Sponsored by DOE

(UCRL-52434-Vol-7) Avail: NTIS HC A02/MF A01

A substitute for Dow Corning DC93-120 silicone potting compound can be formulated from Sylgards 184 and 186 resins and either accelerator QCF3-6559 or DC1107 fluid. Substitutes can also be formulated from Sylgard 186, dielectric gel Q3-6527 and DC1107 or from Sylgard 184, silicone dioxide and accelerator QCF3-6559. Author

N81-16250# Sandia Corp., Livermore, Calif. Applied Physics Div.

GASES IN GLASS

J. E. Shelby Nov. 1980 11 p refs Submitted for publication

(Contract DE-AC04-76DP-00789)

(SAND-80-8811) Avail: NTIS HC A02/MF A01

The high mobility of helium and hydrogen in some glasses was known for many years. The effect of diffusion controlled reactions between glasses and a number of gases on the physical and optical properties of those glasses is also widely recognized. A brief review is presented of the experimental techniques used to study these problems and of the current state of knowledge regarding the solubility, migration and reaction of gases in glasses. E.D.K.

N81-16251# Stevens Inst. of Tech., Hoboken, N. J.

MAXIMIZING THE LIFE CYCLE OF PLASTICS Final Report

W. L. Hawkins Feb. 1980 800 p refs

(Contract EC-77-S-03-1609)

(SAN-1609-T1) Avail: NTIS HC A99/MF A01

Since feedstock for practically all synthetic plastics is derived from fossil fuel, every effort should be made to obtain the maximum useful life from these materials. The extent to which plastic scrap will be recovered and reused will be affected by the economic situation as well as the available supply of fossil fuel. Several areas of plastics research are summarized and include: improved stabilization separation of mixed plastic scrap; compatibilizing agents for mixed plastic scrap; controlled degradation of plastic scrap; and determination of compatibility. T.M.

N81-16252# National Technical Information Service, Springfield, Va.

HIGH TEMPERATURE LUBRICANTS. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1974 - Jul. 1980

Diane M. Cavagnaro Oct. 1980 164 p Supersedes NTIS/PS-79/1033 and NTIS/PS-78/0949

(PB81-800039; NTIS/PS-79/1033; NTIS/PS-78/0949) Avail: NTIS HC $30.00/MF $30.00 CSCL 11H

Citations on high temperature lubricants from worldwide research are presented. The citations cover the composition, properties, testing, uses, performance and wear ability of hydraulic fluids, oils, greases and solid lubricants. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N81-16253* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 17TH JANNAF COMBUSTION MEETING, VOLUME 1
Debra Sue Eggleston, ed. Nov. 1980 669 p refs Meeting held at Hampton, Va., 22-26 Sep. 1980 Prepared in cooperation with APL, Laurel, Md. 4 Vol.
(Contract N00024-78-C-5384)
(NASA-TM-82238; AD-A094820; CPIA-Publ-329-Vol-1) Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The combustion of solid rocket propellants and combustion in ramjets is addressed. Subjects discussed include metal burning, steady-state combustion of composite propellants, velocity coupling and nonlinear instability, vortex shedding and flow effects on combustion instability, combustion instability in solid rocket motors, combustion diagnostics, subsonic and supersonic ramjet combustion, characterization of ramburner flowfields, and injection and combustion of ramjet fuels. For individual titles, see N81-16254 through N81-16287.

N81-16254* Naval Postgraduate School, Monterey, Calif.
PARTICLE BEHAVIOR IN SOLID PROPELLANT ROCKETS
D. W. Netzer, V. D. Diloreto, and E. Dubrov *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 1-20 refs (For primary document see N81-16253 07-28)
(Contract F04611-80-X-0032)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The use of holography, high speed motion pictures, light scattering measurements, and post-fire particle collection/scanning electron microscopic examination to study the combustion of composite solid propellants is discussed. The relative advantages and disadvantages of the different experimental techniques for obtaining two-phase flow characteristics within the combustion environment of a solid propellant grain are evaluated. Combustion bomb studies using high speed motion pictures and post-fire residue analysis were completed for six low metal content propellants. Resolution capabilities and the relationships between post-fire residue and motion picture data are determined. Initial testing using a holocamera together with a 2D windowed motor is also described. M.G.

N81-16255* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBUSTION IN AN ACCELERATION FIELD: A SURVEY OF SOVIET LITERATURE
S. J. Radloff and J. R. Osborn (Purdue Univ., Lafayette, Ind.) *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 21-35 refs (For primary document see N81-16253 07-28)
(Contract F33657-80-C-0100)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The effect of an acceleration field on the burning rate of a solid propellant was measured from -900g's to +1000g's using both double base and ammonium perchlorate based propellants. The acceleration fields were simulated using a centrifuge device and the burning rate was recorded. Both metalized and non-metalized variations of each propellant were tested and it was found that acceleration fields affect the burning rate. For the most part the theoretical predictions and the experimental results agreed. M.G.

N81-16256* Georgia Inst. of Tech., Atlanta.
MICROSTRUCTURE OF THE COMBUSTION ZONE: THIN-BINDER AP-POLYMER SANDWICHES
E. W. Price, R. R. Panyam, and R. K. Sigman *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 37-51 refs (For primary document see N81-16253 07-28)
(Contracts N00014-75-C-0332; N00014-79-C-0764)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Experimental results are summarized for systematic quench-burning tests on ammonium perchlorate-HC binder sandwiches with binder thicknesses in the range 10 - 150 microns. Tests included three binders (polysulfide, polybutadiene-acrylonitrile, and hydroxy terminated polybutadiene), and pressures from 1.4 to 14 MPa. In addition, deflagration limits were determined in terms of binder thickness and pressure. Results are discussed in terms of a qualitative theory of sandwich burning consolidated from various sources. Some aspects of the observed results are explained only speculatively. M.G.

N81-16257* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A MODEL FOR THE BURNING RATES OF COMPOSITE PROPELLANTS
Norman S. Cohen and Leon D. Strand *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 53-97 refs Prepared in cooperation with Cohen (Norman) Professional Services, Redlands, Calif. (For primary document see N81-16253 07-28)
(AFOSR ISSA 79-0016; AFOSR ISSA 80-0017)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

An analytical model of the steady-state burning of composite solid propellants is presented. An improved burning rate model is achieved by incorporating an improved AP monopropellant model, a separate energy balance for the binder in which a portion of the diffusion flame is used to heat the binder, proper use of the binder regression rate in the model, and a model for the combustion of the energetic binder component of CMDB propellants. Also, an improved correlation and model of aluminum agglomeration is developed which properly describes compositional trends. M.G.

N81-16258* Atlantic Research Corp., Alexandria, Va.
PREDICTED AND MEASURED EFFECTS OF PRESSURE AND CROSSFLOW VELOCITY ON COMPOSITE PROPELLANT BURNING RATE
Merrill K. King *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 99-122 refs (For primary document see N81-16253 07-28)
(Contract F49620-78-C-0016)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A theoretical model for prediction of burning rates of composite (ammonium perchlorate oxidizer) solid propellants as a function of pressure and crossflow velocity was developed. Included in this model is the capability for treatment of multimodal oxidizer particle sizes and metalized formulations. In addition, an experimental device for measuring the effects of crossflow velocity on propellant burning rate was developed and used to characterize a series of AP/HTPB propellants with systematically varied formulation parameters. Model predictions of zero-crossflow burning rate versus pressure characteristics were found to be in agreement with data, while the agreement between erosive burning predictions and data is, in general, good. The experimental data indicate that the dominant factor influencing the sensitivity of composite propellant burning rate to crossflow is the base (no-crossflow) burning rate versus pressure characteristics of the propellant (lower base burning rate leading to increased crossflow sensitivity). Finally, the model was used to examine the effects of motor scaling on erosive burning: erosive burning is predicted to diminish with increasing motor size, in agreement with experience. M.G.

N81-16259* Ballistic Research Labs., Aberdeen Proving Ground, Md.
AN IDEALIZED MODEL OF HOMOGENEOUS SOLID PROPELLANT COMBUSTION
Martin S. Miller *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 123-131 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The idealization of solid propellant combustion which consists of a single condensed-phase reaction and a single gas-phase reaction is discussed. A limiting-case solution to the gas-phase conservation equations is developed and tested by comparison with transformed thermocouple data. Closed-form expressions are derived for the burning rate and temperature sensitivity. Both quantities are linked explicitly to the solid and gas activation energies. It is concluded that the combustion phenomenology associated with the above idealization is still not fully understood. It is suggested that a careful study of the various limiting-case solutions tempered by a small set of numerical benchmark calculations might further such understanding. M.G.

N81-16260* Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

EXPERIMENTAL DETERMINATION OF THE ADMITTANCES OF ALUMINIZED PROPELLANTS BY THE IMPEDANCE TUBE METHOD

Joseph D. Baum (Dayton Univ., Ohio), Brady R. Daniel, and Ben T. Zinn *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 133-148 refs (For primary document see N81-16253 07-28)

(Contract F49620-78-C-0003)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The adaptation of the impedance tube concept for the determination of the pressure coupled admittances and response functions of burning solid propellants is discussed. The results obtained in experiments with UTP-3001 and UTP-19360 aluminized propellants are presented. It is shown that the admittance Y remains constant during the quasi-steady burn period of a test, indicating constant driving of the gas phase disturbance by the burning solid propellant. The measured real part of the admittance is positive, indicating that the burning aluminized propellant is driving the gas phase oscillations. In addition, the measured high gas phase damping, provided by the aluminum oxide particles in the gas phase, suggests that the latter can significantly increase the damping in unstable solid rockets over the investigated frequency range. Finally, it is shown that the wave structure obtained by numerically solving the impedance tube wave equations which utilize the determined propellant admittance as an initial condition and the determined value of G to describe the gas phase losses is in excellent agreement with the measured wave structure. M.G.

N81-16261* United Technologies Corp., Sunnyvale, Calif. Chemical Systems.

ANALYSIS OF VELOCITY-COUPLED RESPONSE FUNCTION DATA FROM THE DUAL ROTATING VALVE

R. S. Brown and R. C. Waugh *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 149-168 refs (For primary document see N81-16253 07-28)

(Contract F49620-77-C-00448)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The results of a re-evaluation of the propellant combustion data obtained using the dual valve approach for measuring velocity-coupling characteristics of solid propellants are presented. Data analysis and testing procedures are described. The velocity response is compared to pressure-coupled response data within the context of thermal wave response theory. This comparison shows important inconsistencies which cast doubt on inferring the velocity response from pressure-coupled response functions. M.G.

N81-16262* Thiokol Corp., Huntsville, Ala.

AN EMPIRICAL PROPELLANT RESPONSE FUNCTION FOR COMBUSTION STABILITY PREDICTIONS

R. O. Hessler *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 169-193 refs (For primary document see N81-16253 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

An empirical response function model was developed for ammonium perchlorate propellants to supplant T-burner testing at the preliminary design stage. The model was developed by fitting a limited T-burner data base, in terms of oxidizer size and concentration, to an analytical two parameter response function expression. Multiple peaks are predicted, but the primary effect is of a single peak for most formulations, with notable bulges for the various AP size fractions. The model was extended to velocity coupling with the assumption that dynamic response was controlled primarily by the solid phase described by the two parameter model. The magnitude of velocity coupling was then scaled using an erosive burning law. Routine use of the model for stability predictions on a number of propulsion units indicates that the model tends to overpredict propellant response. It is concluded that the model represents a generally conservative prediction tool, suited especially for the preliminary design stage when T-burner data may not be readily available. The model work included development of a rigorous summation technique for pseudopropellant properties and of a concept for modeling ordered packing of particulates. M.G.

N81-16263* Brigham Young Univ., Provo, Utah.

WORKSHOP REPORT: VELOCITY COUPLING

Merrill W. Beckstead *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 195-200 (For primary document see N81-16253 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Velocity coupled combustion instability and related combustion instability topics were considered. The knowledge of velocity coupled combustion instability was assessed; the state of the art of velocity coupled measurement techniques was determined; and particularly laboratory devices or T burner related devices; recommendations were made on how to improve the state of knowledge on velocity coupled combustion instability. Test conditions for a round robin of velocity coupled response measurement techniques were established. A.R.H.

N81-16264* Naval Ordnance Station, Indian Head, Md.

USE OF A HELMHOLTZ BURNER FOR LOW FREQUENCY VELOCITY COUPLED INSTABILITY MEASUREMENTS

J. M. Lyon and J. E. Crump (Naval Weapons Center) *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 201-220 refs (For primary document see N81-16253 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The low frequency velocity coupled response of a composite propellant during combustion was investaged using a Helmholtz resonator in the burner which results in a 230 Hz natural frequency in a chamber less than 30 inches long. Experiments indicate that the acoustic characteristics of the burner permit determination of propellant velocity coupled without prior knowledge of pressure coupled response. Comparisons of burner data and full scale motor firings confirm the ability of the burner to rank propellants for their velocity coupling tendencies. The burner design rationale is described and experimental results are presented.

Author

N81-16265* Paris-Sud Univ., Orsay (France).

NUMERICAL TECHNIQUES FOR SOLVING NONLINEAR INSTABILITY PROBLEMS IN SMOKELESS TACTICAL SOLID ROCKET MOTORS

J. D. Baum and J. N. Levine (AFRPL) *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 221-256 refs (For primary document see N81-16253 07-28)

(Contract F04611-77-C-0042)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The selection of a satisfactory numerical method for calculating the propagation of steep fronted shock life waveforms in a solid rocket motor combustion chamber is discussed. A number of different numerical schemes were evaluated by comparing the results obtained for three problems: the shock tube problems; the linear wave equation, and nonlinear wave propagation in a closed tube. The most promising method--a combination of the Lax-Wendroff, Hybrid and Artificial Compression techniques, was incorporated into an existing nonlinear instability program. The capability of the modified program to treat steep fronted wave instabilities in low smoke tactical motors

was verified by solving a number of motor test cases with disturbance amplitudes as high as 80% of the mean pressure.
A.R.H.

N81-16266* Utah Univ., Salt Lake City.
MODELING OF VORTEX GENERATED SOUND IN SOLID PROPELLANT ROCKET MOTORS
G. A. Flandro *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 257-268 refs (For primary document see N81-16253 07-28)
(Contract F04701-77-C-0060)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

There is considerable evidence based on both full scale firings and cold flow simulations that hydrodynamically unstable shear flows in solid propellant rocket motors can lead to acoustic pressure fluctuations of significant amplitude. Although a comprehensive theoretical understanding of this problem does not yet exist, procedures were explored for generating useful analytical models describing the vortex shedding phenomenon and the mechanisms of coupling to the acoustic field in a rocket combustion chamber. Since combustion stability prediction procedures cannot be successful without incorporation of all acoustic gains and losses, it is clear that a vortex driving model comparable in quality to the analytical models currently employed to represent linear combustion instability must be formulated.
Author

N81-16267* Georgia Inst. of Tech., Atlanta.
INTERACTION OF OSCILLATIONS OF CHANNEL FLOW AND FLOW SEPARATION AT DUCT DISCONTINUITIES
E. W. Price, J. E. Hubbartt, W. C. Strahle, E. A. Oguz, and P. M. Sagdeo *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 269-287 (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A two dimensional experiment was used to study the flow fluctuations in the separated region resulting from a wall slot step (convergent step). This geometry corresponds to the geometry present in a segmented solid rocket motor in the region of the ends of adjoining segments. A modulated tunnel flow of controlled oscillation frequency was used, and the effect on flow fluctuations in the separated region was examined by hot wire velocity measurements. The transfer function between free stream oscillations and separated flow fluctuations at the driven frequency was determined over a range of frequencies and main stream flow velocities. The transfer function exhibited a frequency dependence with maximum in the 10 - 25 Hz range, with the maximum occurring at higher frequency when the mean flow velocity was higher.
Author

N81-16268* Thiokol Corp., Huntsville, Ala.
PREDICTION OF FINITE PRESSURE OSCILLATIONS IN STABLE ROCKET MOTORS
R. O. Hessler *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 289-300 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A methodology is outlined for predicting the amplitude of forced vibrations in the acoustic cavity of a solid rocket motor. The equation for forced vibration of the motor cavity acoustic system is written by parallel with the acoustic mechanical analogy. Acoustic and aeroacoustic theory are used to predict the frequency and intensity of vortex systems or turbulence created by passage of the mean flow over geometric discontinuities in the motor port. Approximate methods are presented for coupling the acoustic field due to the flow noise with the chamber acoustics and for summing the effect upon the multiple acoustic modes.
Author

N81-16269* Utah Univ., Salt Lake City.
AN INVESTIGATION OF THE ORIGIN OF THE FLOW TURNING EFFECT IN COMBUSTION STABILITY ANALYSIS
W. K. VanMoorhem *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 301-320 refs (For primary document see N81-16253 07-28)
(Grant AF-AFOSR-3645-78)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The concept of a 'flow turning' effect in the combustion based on the fact that terms appear in the equations governing the acoustic oscillations in a one dimensional model of combustion in a solid propellant rocket that do not appear in a three dimensional model. A procedure is developed to allow comparison of one and three dimensional models by averaging over the cross section of the motor cavity. Results indicate that the one dimensional equations with mass addition do not contain any physical phenomena that are missing the three dimensional equations with appropriate boundary conditions. This raises significant questions about any procedure that is based on the difference between one and three dimensional results.
A.R.H.

N81-16270* California Inst. of Tech., Pasadena.
MEASUREMENTS OF INTERACTIONS BETWEEN ACOUSTIC FIELDS AND NONUNIFORM MEAN FLOW
K. Magiawala, J. Wat, E. Awad, F. E. C. Culick, and T. Kubota *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 321-336 refs Sponsored by AF (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Two problems crucial to the stability of longitudinal acoustic waves in solid rocket motors were examined experimentally. The first is the dissipation of energy associated with an average flow inward at the lateral boundary. Measurements reported here, though subject to considerable experimental error, show that the actual losses are much larger than predicted by the approximate one dimensional analysis. The second problem is the attenuation of waves accompanying reflection by the nonuniform flow in a choked exhaust nozzle. Emphasis on technique, to provide data relatively easily and inexpensively. It appears that good results can be obtained in a routine manner using small supersonic wind tunnel operated as an open cycle. At least for Mach numbers up to 0.04 at the nozzle entrance, difficulties with signal/noise are satisfactorily overcome with a tracking filter.
Author

N81-16271* Naval Weapons Center, China Lake, Calif. Aerothermochemistry Div.
A NEW ASSESSMENT OF CHAMBER PRESSURE OSCILLATIONS IN THE SHUTTLE SRB
H. B. Mathes *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 337-342 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Oscillatory data from three static firings of the shuttle SRB are analyzed. The data from these and four additional motors were pooled and predictions made for the maximum amplitude and range of frequency to be expected in future motor firings. The predictions form the basis for various studies by other groups of the shuttle's response to vibration generated by the SRB's.
A.R.H.

N81-16272* Naval Ordnance Station, Indian Head, Md.
MECHANICAL SUPPRESSION: MODERN TECHNOLOGY APPLIED TO AN OLD ART
W. H. Crockford, T. E. Durney, D. E. Scott, and J. A. Condon *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 343-388 refs Prepared in cooperation with Hercules, Inc., Cumberland, Md. (For primary document see N81-16253 07-28)
(Contract N00174-77-C-1282)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Various suppressor configurations were analyzed and evaluated in an effort to reduce combustion instability and improved ballistic reproducibility of the MK 12 motor. A static firing test series of eight field return boosters featured two baseline motor firings with the existing suppressor in each motor, followed by two tests each of two different prototype suppressor designs. Results were analyzed and used to generate the design for the final two firings. Acoustic pressure pulsers were utilized to measure the damping effectiveness of the final design. The reduction in

motor vibration and acoustic pressure levels between the baseline tests and the final two improved lightweight tests was significant. The average acceleration level of the motors equipped with flightweight rods was reduced to only 5% of the level in the unmodified motors; the average acoustic pressure level was reduced to 20%; maximum values were reduced to 6% for acceleration and 23% for pressure. A.R.H.

N81-16273* Utah Univ., Salt Lake City.
TANGENTIAL MODE COMBUSTION INSTABILITY OF SOLID PROPELLANT ROCKET MOTORS. 2: PRESSURE, FREQUENCY, AND BURNING RATE HISTORIES
G. A. Flandro, L. S. Bain, R. S. Brown, T. O. Morgan, and T. P. Rudy *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 389-403 refs Prepared in cooperation with United Technologies Corp., Sunnyvale, Calif. (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The relationships among excursions of mean chamber pressure, high frequency pressure oscillations and accelerations associated with tangential mode combustion instability are considered. A data reduction procedure was devised to utilize the precise pressure time data as input to a numerical solution of the chamber mass balance relationships. The results indicate that both elevated burning rate induced by the tangential wave motions and variable nozzle blockage due to passage of vortical flow through the nozzle throat must act together to generate the large mean pressure peaks observed in the tests. There is strong correlation between the amplitude of wave motions and the level of mean pressure rise. Evidence for the presence of traveling tangential waves at the time of the D.C. shift was found by use of dual Kistler pressure transducers mounted at the head end of the burner. A very unusual frequency history was found to accompany the high amplitude disturbances. This was consistent from test to test and may represent an additional source of information regarding the complicated flow combustion interactions within the propellant burning zone. A.R.H.

N81-16274* Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
THE ESTIMATION OF DECAY COEFFICIENT IN PULSED TRANSIENT DATA
T. W. Park, W. Andrepont, and C. J. Park (San Diego State Univ.) *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 405-416 refs (For primary document see N81-16253 07-28)
(Contract F49620-79-C-0038)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The problem of estimation and interpretation of a decay coefficient in a pulsed transient signal is considered. Two methods are proposed in estimating the decay coefficient of pulsed decay transient data. The methods are derived through a spectral analysis for a parametric model of impulse response function of signal frequency. The several pulsed response data from T burner tests as well as some synthesized data are analyzed and the performance of the estimation procedures are examined. Suggestions for further research in this area are offered. The estimation procedures presented can be extended to the case of multiple frequencies in pulse response function and time dependent decay or growth coefficients. Author

N81-16275* Dayton Univ., Ohio.
DESIGN AND USE OF A SERVO-CONTROLLED HIGH PRESSURE WINDOW BOMB IN SPECTROSCOPIC STUDIES OF SOLID PROPELLANT COMBUSTION
F. Goetz and D. M. Mann (AFRPL) *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 417-434 refs (For primary document see N81-16253 07-28)
(Contract F04611-77-C-0042)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The feasibility of using a high pressure window bomb as a laboratory scale model of actual motor conditions. The design and operation of a modified high pressure window bomb is discussed. An optical servocontrol mechanism has been designed to hold the burning surface of a propellant strand at a fixed position within the bomb chamber. This mechanism permits the recording of visible and infrared emission spectra from various propellants. Preliminary visible emission spectra of a nonmetalized and metalized propellant are compared with spectra recorded using the modified bomb. R.C.T.

N81-16276* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A HIGH SPEED NON-INTRUSIVE TEMPERATURE DIAGNOSTIC FOR COMBUSTION PROCESSES
R. W. McCullough, D. H. Burde, G. B. Northam, and J. S. Evans *In its* The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 435-457 Prepared in cooperation with Aeronautical Research Associates of Princeton, Inc., N.J. (For primary document see N81-16253 07-28)
(Contract NAS1-14853)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A temperature diagnostic for high speed measurement of combustion gases is described. The technique monitors ultraviolet absorption by OH radicals of narrow line resonance radiation produced in a flowing microwave discharge. Quartz fiber optics are used extensively to transport the signal to and from the combustor as well as within the device. A high speed computer data acquisition system is used which permits time resolved temperature measurements in excess of 10 KHz. The theoretical basis for the measurement is outlined. R.C.T.

N81-16277* Ballistic Research Labs., Aberdeen Proving Ground, Md.
PULSED HOLOGRAPHY FOR COMBUSTION DIAGNOSTICS
Nathan Klein and Mark A. Dewilde *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 459-467 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Image reconstruction and data extraction techniques were considered with respect to their application to combustion diagnostics. A system was designed and constructed that possesses sufficient stability and resolution to make quantitative data extraction possible. Example data were manually processed using the system to demonstrate its feasibility for the purpose intended. The system was interfaced with the PDP-11-04 computer for maximum design capability. It was concluded that the use of specialized digital hardware controlled by a relatively small computer provides the best combination of accuracy, speed, and versatility for this particular problem area. R.C.T.

N81-16278* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INSTANT-REPLAY DATA SYSTEM FOR COMBUSTION TESTS
C. A. Trexler *In its* The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 469-479 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A portable, inexpensive, easily programmed and yet flexible pressure measuring and display system with quick turn around was evaluated in a multiport combustion model and found to perform well within specifications. The system offers the test engineer an economical, yet accurate and easy to use method of recording and comparing a large number of pressures at high data rates. The system also allows display of the results in meaningful graphical form for near real time analysis. The system has the ability to take and store large quantitites of data and obtain an immediate glance at selected portions for diagnostics purposes. R.C.T.

N81-16279* University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
EXPERIMENTS ON MULTIPLE VORTICES IN A SIDE DUMP GAS GENERATOR RAMJET
P. R. Choudhury *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 481-488

refs (For primary document see N81-16253 07-28)
(Grant AF-AFOSR-3354-77)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The role of multiple vortices in the flame stabilization process of a 4 inlet side dump ramjet was determined. Very rich propane air mixtures were injected at the head to simulate a gas generator ramjet. Swirl was introduced by canting the inlets at the dump station. The inlet angle, swirl angle, and the distance of the head from the dump station were varied over a wide range to determine the importance of the vortices located at the dump stations and at the head. It is shown that with proper design, the vortex at the head can be made to perform as a pilot burner allowing a great deal of versatility of operation and it appears to provide all the criteria of pollution free operation.
R.C.T.

N81-16280* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLAMEHOLDING CHARACTERISTICS OF A SWEPT-STRUT H2 FUEL-INJECTOR FOR SCRAMJET APPLICATIONS
G. B. Northam, C. A. Trexler, and C. R. McClinton *In its* The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 489-507 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A series of direct connect tests which simulate the flow around the center swept strut fuel injector of a scramjet engine module were conducted. The experimental geometry included both perpendicular and parallel fuel injectors which were swept with respect to the upstream flow direction in a manner which simulated the flow geometry in the combustion region of the scramjet. The flow Mach number upstream of injection corresponded to Mach 4 flight for this engine inlet design. Test gas stagnation temperature was varied from 550 to 1700 K. Seven different strut injector geometries were evaluated for their combustion performance, flameholding, and inlet combustor interaction characteristics.
R.C.T.

N81-16281* ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL INVESTIGATION OF REACTIVE TURBULENT RECIRCULATING JET MIXING IN A DUMP
Gary D. Smith, Thomas V. Giel, and Carl G. Catalano *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 509-529 refs Sponsored by AF (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A ducted, subsonic, hydrogen air turbulent jet mixing flowfield was investigated, both with and without combustion. The geometric configuration was representative of a sudden expansion or dump combustor, with a central air jet surrounded by a low velocity hydrogen stream at an overall equivalence ratio of 0.12. The ratio of the duct to inner nozzle diameter was 2.5. Radial distributions of mean axial and radial velocity, axial and radial turbulent intensity, velocity cross correlation, gas composition, static temperature and total pressure, as well as axial distributions of wall static pressure, were obtained for axial stations from zero to six duct diameters from the combustor entrance. The data indicate that mixing is slower in the chemically reactive flow field than in the nonreactive flow field, and that the presence of combustion has a significant effect on the size and location of the recirculation zone within the mixing duct.
Author

N81-16282* Naval Postgraduate School, Monterey, Calif.
COMBUSTION BEHAVIOR OF SOLID FUEL RAMJETS
D. W. Netzer, B. A. Binn, W. E. Scott, and M. Metochianakis *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 531-551 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Nonreacting flowfield characteristics and fundamental fuel properties are considered with respect to their use in estimating the obtainable combustion efficiency for fuels and/or combustor geometries. It is shown that near wall turbulence intensity in nonreacting flow appears to correlate reasonably well with the fuel regression pattern in identical geometries. The HTPB based fuels exhibit solid phase exothermic reactions in contrast to purely endothermic reactions for plexiglas. It is further shown that combustion pressure oscillations appear to be related to physically induced disturbances to the fluctuating shear layers at the fuel grain and aft mixing chamber inlets.
R.C.T.

N81-16283* Naval Weapons Center, China Lake, Calif.
STUDIES OF PRESSURE OSCILLATIONS IN A RESEARCH DUMP COMBUSTOR Progress Report
K. C. Schadow, J. E. Crump, R. L. Derr, and J. S. Heaser *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 553-559 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A coaxial research dump combustor was used to investigate the acoustic modes structure and its effect on the inlet shock system. Acoustic wave structure was determined including the amplitude, frequency, and phase as a function of position. Inlet shock position, shock displacement, shock displacement frequency, and phase relative to acoustic wave structure were also defined. All results were compared to with one dimensional modeling.
R.C.T.

N81-16284* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A NUMERICAL STUDY OF CANDIDATE TRANSVERSE FUEL INJECTOR CONFIGURATIONS IN THE LANGLEY SCRAMJET ENGINE
J. Philip Drummond and Elizabeth H. Weidner *In its* The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 561-586 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

A computer program was developed that numerically solves the two dimensional Navier-Stokes and species equations near one or more transverse hydrogen fuel injectors in a scramjet engine. The program computed the turbulent mixing and reaction of hydrogen fuel and air, and allowed the study of separated regions of the flow immediately preceding and following the injectors. The complex shock expansion structure produced by the injectors in this region of the engine was also represented. Results are presented that describe the flow field near two opposing transverse fuel injectors and two opposing staged (multiple) injectors, and comparisons between the two configurations are made to assess their mixing and flameholding qualities.
R.C.T.

N81-16285* Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
TRANSVERSE INJECTION OF A PARTICLE-LADEN LIQUID JET IN SUPERSONIC FLOW: A THREE-PHASE FLOW
J. A. Schetz and J. C. Ogg *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 587-604 refs Sponsored by AF (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

The results of a two part study of the behavior of particle laden liquid jets injected into air are presented. Water was used as the liquid carrier and either 1-37 or 13-44 microns diam. spherical glass beads with a specific gravity of 2.8-3.0 as the particles. The observations were mainly photographic. The breakup of jets injected into still air was investigated as a function of particle loading, and the results were compared to the pure liquid jet case. The jets were found to be more stable with particles present. The length to breakup was increased, and the formation of satellite droplets was suppressed. The penetration and breakup of transverse jets in a Mach 3.0 air stream was studied. The general breakup mechanism of wave formation was found to be the same as for the all liquid case. Significant separation of the phases was observed, and the penetration of the liquid phase was reduced compared to all liquid cases at the same value of the jet to free stream momentum flux ratio.
R.C.T.

N81-16286* Exxon Research and Engineering Co., Linden, N.J.
HIGH DENSITY CARBON DISPERSION FUELS PROGRAM

Status Report
R. H. Salvesen and M. Lavid *In* NASA. Langley Research Center The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 605-638 refs (For primary document see N81-16253 07-28)
(Contract F33615-78-C-2025)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

High density carbon dispersion fuels were studied. Promising results were obtained which indicate stable carbon loaded fuels with a minimum of 180,000 Btu per gallon can be made and successfully burned in prototype turbine combustors components. Tests were completed which provide insights to obtaining a better understanding of what types of carbon can be successfully formulated and combusted. R.C.T.

N81-16287* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
USE OF SILANE IN SCRAMJET RESEARCH
H. L. Beach, Jr., E. A. Mackley, R. C. Rogers, and W. Chinitz (Cooper Union Research Foundation, Inc., New York) *In its* The 17th JANNAF Combust. Meeting, Vol. 1 Nov. 1980 p 639-659 refs (For primary document see N81-16253 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21D

Mono-silane (SiH4) in mixtures with hydrogen is identified as a promising ignitor and pilot fuel for use in ground tests of hydrogen-fueled scramjet engines. Results from engine tests at conditions simulating Mach 7 and Mach 4 show that performance at approximately 90 percent of the target value is achieved at high equivalence ratio with silane piloting. Flameholding with hydrogen alone is achieved with silane ignition. A chemical kinetic mechanism for silane obtained by analog with methane is presented along with calculations of ignition delay for silane/hydrogen/air mixtures. R.C.T.

N81-16288* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 17TH JANNAF COMBUSTION MEETING, VOLUME 2
Debra Sue Eggleston, ed. Nov. 1980 569 p refs Conf. held at NASA Langley Research Center, Hampton, Va., 22-26 Sep. 1980 Prepared in cooperation with APL, Laurel, Md.
(Contract N00024-78-C-5384)
(NASA-TM-82237; AD-A094821; CPIA-Publ-329-Vol-2) Avail:
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL CSCL 21D

Combu. ion of gun and nitramine propellants are discussed. Topics include gun charge designs, flame spreading in granular and stick charges, muzzle flash, ignition and combustion of liquid propellants for guns, laminar flames, decomposition and combustion of nitramine ingredients and nitramine propellant development. For individual titles, see N81-16289 through N81-16309.

N81-16289* Princeton Combustion Research Labs., Inc., N.J.
THEORY OF BUBBLE DYNAMICS IN CONDENSED EXPLOSIVE DURING START-UP TRANSIENT
M. BenReuven and M. Summerfield *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 259-286 refs (For primary document see N81-16288 07-28)
(Contract DAAK10-78-C-0315)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Test firings with experimental liquid propellant gun systems indicate that the main concern standing in the way of practical application of LPG's is the possibility of unexpected explosions during start up when pressure is rapidly applied to the liquid monopropellant in the chamber. The phenomenon of many collapse-rebound cycles of imploding bubbles is theorized as the probable cause of explosions in LP systems. It may be concluded that LPG safety would be enhanced by choosing an LP with low bulk modulus, as well as low decomposition reaction rate, and that a benign looking DTA trace is not a sufficient guarantee of insensitivity to a pressure induced explosion. It is also shown that pre-pressurizing an LP charge, thus pre-compressing the bubbles near-isothermally, makes the system relatively insensitive to such pressure induced explosions. The applicability of this analysis to the question of acceleration induced explosion of explosive filled warheads is indicated. E.D.K.

N81-16290* Ballistic Research Labs., Aberdeen Proving Ground, Md.
A MECHANISM FOR THE COMPRESSIVE IGNITION OF LIQUID MONOPROPELLANTS Progress Report
Walter F. Morrison, John D. Knapton, and John Mandzy *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 287-307 refs Prepared in cooperation with General Electric Ordnance Systems, Pittsfield, Mass. (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Possible mechanisms for compressive ignition of liquid monopropellants are discussed. These mechanisms all involve the collapse of a gas filled bubble imbedded in the liquid. A model of the collapse of a gas bubble in an incompressible liquid and the combustion of the surrounding liquid after ignition occurs is presented. The effect of gas covolume, liquid density, the adiabatic exponent, rate of pressurization and prepressurization are investigated. Calculations for finite and infinite liquid volumes are also presented. Gas generation in the bubble is shown to have a significant effect on its evolution and the introduction of a surface enhancement factor leads to a runaway reaction. For the conditions considered, the reacting bubble oscillates at a frequency of about 35 kHz over the first 0.5 milliseconds. This frequency decreases as the surface enhancement factor is increased. The implication is that a one dimensional model of this process may be tractable from the standpoint of computer time. Author

N81-16291* General Electric Co., Pittsfield, Mass.
COMPRESSION IGNITION SENSITIVITY OF NOS-365 UNDER RAPID PROPELLANT FILL CONDITIONS Progress Report
John Mandzy, K. Schaefer, John D. Knapton, and Walter F. Morrison *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2 Nov. 1980 p 309-327 refs Prepared in cooperation with the Ballistic Res. Labs., Aberdeen Proving Ground, Md. (For primary document see N81-16288 07-28)
(Contract DAAK11-78-C-0054)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The ullage compression ignition sensitivity of NOS-365 monopropellant under the pressure condition expected to be found in a medium caliber regenerative liquid propellant gun is evaluated. The results from the rapidly loaded propellant tests performed to date are presented. For this case, the physical state of the propellant is characterized by the presence of turbulence and a finely distributed ullage field. A description of the test fixtures, procedures and results is given. It is argued that the results to date indicate that with relatively simple precautionary measures NOS-365 can be rendered sufficiently immune to the ullage compression ignition mechanism to permit it to be safely used in a regenerative liquid propellant gun. E.D.K.

N81-16292* Ballistic Research Labs., Aberdeen Proving Ground, Md.
UNIMOLECULAR DECOMPOSITION REACTIONS AT LOW-PRESSURE: A COMPARISON OF COMPETITIVE METHODS
George F. Adams *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2 Nov. 1980 p 329-342 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The lack of a simple rate coefficient expression to describe the pressure and temperature dependence hampers chemical modeling of flame systems. Recently developed simplified models to describe unimolecular processes include the calculation of rate constants for thermal unimolecular reactions and recombinations at the low pressure limit, at the high pressure limit and in the intermediate fall-off region. Comparison between two different applications of Troe's simplified model and a comparison between the simplified model and the classic RRKM theory are described. E.D.K.

N81-16293* Ballistic Research Labs., Aberdeen Proving Ground, Md.
A COMPARISON OF TRANSPORT ALGORITHMS FOR PREMIXED, LAMINAR STEADY STATE FLAMES
T. P. Coffee and J. M. Heimerl *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980

p 343-363 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The effects of different methods of approximating multispecies transport phenomena in models of premixed, laminar, steady state flames were studied. Five approximation methods that span a wide range of computational complexity were developed. Identical data for individual species properties were used for each method. Each approximation method is employed in the numerical solution of a set of five H2-02-N2 flames. For each flame the computed species and temperature profiles, as well as the computed flame speeds, are found to be very nearly independent of the approximation method used. This does not indicate that transport phenomena are unimportant, but rather that the selection of the input values for the individual species transport properties is more important than the selection of the method used to approximate the multispecies transport. Based on these results, a sixth approximation method was developed that is computationally efficient and provides results extremely close to the most sophisticated and precise method used. E.D.K.

N81-16294* Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE MULTISPECIES MODELING OF THE PREMIXED, LAMINAR STEADY-STATE OZONE FLAME

Joseph M. Heimerl and Terance P. Coffee IN NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 365-377 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Species dependent kinetic, transport and thermodynamic coefficients were employed in a one dimensional model of the premixed, laminar, steady state ozone flame. Convenient expressions for these coefficients are reported. They are based on independent measurements, no arbitrary parameters are used. The governing equations are solved using a relaxation technique and the partial differential equation package, PDECOL. Species and temperature profiles and the burning velocities are found over the range of initial ozone mole fraction of 0.25 to 1.00. The computed burning velocities are no more than 30% greater than the measurements of Streng and Grosses. Comparison with the computed results of Warnatz shows agreement within + or - 12%, even though quite different expressions for some of the kinetic coefficients were used. These differences are most obvious in the atomic oxygen and temperature profiles at an initial ozone mole fraction of unity. E.D.K.

N81-16295* Geo-Centers, Inc., Newton, Mass.

COHERENT ANTI-STOKES RAMAN SPECTROSCOPY (CARS) OF GUN PROPELLANT FLAMES

M. E. McIlwain and L. E. Harris (ARRADCOM, Dover, N.J.) *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 379-39p refs (For primary document see N81-16288 07-28)
(Contract DAAG29-78-C-0144)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Temperature measurements were made in a slightly fuel rich, premixed propane/air reference flame and nitrate ester propellant flames burning in air at atmospheric pressure using coherent anti-stokes raman scattering (CARS). Both single and multiple pulse CARS spectra of nitrogen in the reference flame were in good agreement with calculated and reported values. Single pulse CARS nitrogen spectra obtained in the propellant flames were analyzed to give temperatures consistent with values calculated using the NASA-Lewis thermochemical calculation. Comparison of a 0.1 second separated sequence of single pulse CARS spectra indicate turbulent air mixing in these propellant flames. The CARS spectral results demonstrate that temporal and spatially resolved temperature measurements could be determined in transient, turbulent flames. Author

N81-16296* Ballistic Research Labs., Aberdeen Proving Ground, Md.

RAMAN SPECTROSCOPY OF PREMIXED CH4/N20 FLAMES

R. A. Beyer and J. A. Vanderhoff *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 391-399 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Spontaneous Raman spectroscopy was used to make temperature and number density profile measurements in CH4/N20 flames. Preliminary measurements above the primary reaction zone agree with thermochemical equilibrium calculations. A temperature profile was measured through the primary reaction zone of this flame. This profile clearly demonstrates the capability of this diagnostic tool to make accurate temperature measurements with good spatial resolution. Author

N81-16297* Naval Weapons Center, China Lake, Calif.

GAS PHASE KINETICS DURING NORMAL COMBUSTION

C. F. Price, T. L. Boggs, J. L. Eisel, A. I. Atwood, and D. E. Zurn *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 401-411 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The role of gas phase kinetics during combustion was explored in the steady state modeling efforts and in the analysis of ignition phenomena. In both cases it was shown that the combustion characteristics of some high energy ingredients and propellants are strongly affected, if not dictated, by the gas phase reactions which take place. E.D.K.

N81-16298* Ballistic Research Labs., Aberdeen Proving Ground, Md.

BURNING RATE FOR STEEL-CASED, PRESSED BINDERLESS HMX

Robert A. Fifer and James E. Cole *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 413-429 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The burning behavior of pressed binderless HMX laterally confined in 6.4 mm i.d. steel cases was measured over the pressure range 1.45 to 338 MPa in a constant pressure strand burner. The measured regression rates are compared to those reported previously for unconfined samples. It is shown that lateral confinement results in a several-fold decrease in the regression rate for the coarse particle size HMX above the transition to super fast regression. For class E samples, confinement shifts the transition to super fast regression from low pressure to high pressure. Thes3 results are interpreted in terms of the previously proposed progressive deconsolidation mechanism. Preliminary holographic photography and closed bomb tests are also described. Theoretical one dimensional modeling calculations were carried out to predict the expected flame height (particle burn out distance) as a function of particle size and pressure for binderless HMX burning by a progressive deconsolidation mechanism. E.D.K.

N81-16299* Naval Weapons Center, China Lake, Calif.

THE COMBUSTION OF HMX

T. L. Boggs, C. F. Price, A. I. Atwood, D. E. Zurn, and J. L. Eisel *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 431-439 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The burn rate of HMX was measured at high pressures (p more than 1000 psi). The self deflagration rate of HMX was determined from 1 atmosphere to 50,000 psi. The burning rate shows no significant slope breaks. R.C.T.

N81-16300* Princeton Combustion Research Labs., Inc., N.J.

ANALYSIS OF SOLID PROPELLANT COMBUSTION IN A CLOSED VESSEL INCLUDING SECONDARY REACTION

M. BenReuven and M. Summerfield *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 441-459 refs (For primary document see N81-16288 07-28)
(Contract DAAK10-80-M-2492)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

A theory for combustion of solid propellants in a closed vessel is presented allowing for residual exothermic chemical reaction in the bulk of the gas in the vessel. Particular attention is given to propellants exhibiting thick gaseous flame zones such as nitrocellulose, double-base and nitramine propellants. For these, the reaction at high pressures is assumed to involve mainly the

oxidation of residual hydrocarbons by NO. It is shown that the direct dynamic coupling between the exothermicity, the molecular weight reduction and the changing pressure can influence the dp/dt-p traces obtained, in a manner not directly related to mass burning rate of the solid. Energy and species conservation equations are derived for the bulk of the vessel in differential form; the system is solved numerically. The results show the effect of extended chemical reaction upon measurable combustion characteristics such as dp/dt-p and burn rate pressure exponent, demonstrating its potential importance in interpretation of closed vessel firing data, depending on the pace of the residual gas phase reactions. R.C.T.

N81-16301* Naval Weapons Center, China Lake, Calif. Chemistry Div.

SURFACE PROPERTIES OF HMX CRYSTAL Progress Report

R. Y. Yee, A. Adicoff, and E. J. Dibble *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 461-468 refs (Fo. primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The surface properties of Beta-HMX crystals were studied. The surface energies of three principal crystal faces were obtained by measuring contact angles with several reference liquids. The surface energies and polarity of the three crystal faces are found to be different. R.C.T.

N81-16302* Ballistic Research Labs., Aberdeen Proving Ground, Md.

SHOCK TUBE PROPELLANT REACTIONS: IGNITION OF M-9 AND CATALYSIS OF RDX

A. Cohen and L. J. Decker *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 469-478 refs (For primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The preliminary results of shock tube experiments to study RDX catalysis are presented. It is shown that using N2 as the test gas (P approximately equal to 90 KPa, T bar approximately equal to 650K), the replacement of RDX powder with NaBH4 (20% by weight) leads to a large increase in the amount of RDX reacting and a small decrease in ignition delays T sub i. It is further shown that higher temperatures due to exothermic pyrolysis reactions of NaBH4 are not responsible for these effects. Replacement of N2 by NO2 (10% by volume) in the environment of RDX powders (T bar approximately equal to 650K, P = 90-400 KPa) leads to an increase in T sub i and T sub i is directly proportional to NO2 pressure. Inhibition appears to be initiated by reactions between NO2 and either RDX or the RDX decomposition products. R.C.T.

N81-16303* Naval Surface Weapons Center, White Oak, Md.

THE THERMAL DECOMPOSITION OF 1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE (RDX) AND RDXD6 AT HIGH TEMPERATURES

P. J. Miller, G. W. Nauflett, D. W. Carlson, and J. W. Brasch, Sr. *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 479-491 refs (For primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The ballistics behavior of nitramine propellants containing RDX in an inert binder was examined. It is shown that at 2000 to 5000 psi, depending on the particle size, a slope break or discontinuity in the log burning rate versus log pressure curve occurs. It is shown that at higher pressures the nitramine decomposition proceeds predominately by C-N bond rupture and gives CH2 and N20. At still higher pressures (after the slope break) the decomposition proceeds by N-N rupture. The decomposition of RDX was investigated from 170 to 800 C at atmospheric pressure. The major decomposition products were CH2, CO, CO2, N20, N2, and H20. The ratio of the products varied with the pyrolysis rate and temperature. R.C.T.

N81-16304* Ballistic Research Labs., Aberdeen Proving Ground, Md.

CRITICAL ANALYSIS OF NITRAMINE DECOMPOSITION DATA: ACTIVATION ENERGIES AND FREQUENCY FACTORS FOR HMX AND RDX DECOMPOSITION

Michael A. Schroeder *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 493-507 refs (For primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

A summary of a literature review on thermal decomposition of HMX and RDX is presented. The decomposition apparently fits first order kinetics. Recommended values for Arrhenius parameters for HMX and RDX decomposition in the gaseous and liquid phases and for decomposition of RDX in solution in TNT are given. The apparent importance of autocatalysis is pointed out, as are some possible complications that may be encountered in interpreting extending or extrapolating kinetic data for these compounds from measurements carried out below their melting points to the higher temperatures and pressure characteristic of combustion. R.C.T.

N81-16305* Naval Weapons Center, China Lake, Calif.

A CONTRIBUTION TO THE KNOWLEDGE OF HMX DECOMPOSITION AND APPLICATION OF RESULTS

K. J. Kraeutle *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 509-525 refs (For primary document see N81-16288 07-28) (SR2402002)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The decomposition of cyclotramethylenetetranitramine (HMX) in the solid and liquid phase was studied by isothermal and nonisothermal heating at atmospheric pressure. Decomposition rates of solid HMX changed with sample size and gaseous environment. Kinetic parameters were obtained from weight loss measurements in the temperature range 229 C - 269 C. These tests also yielded highly porous solid residues. Qualitative aspects of solid and liquid phase decomposition of HMX with additives were also investigated in isothermal and nonisothermal tests. Author

N81-16306* Naval Surface Weapons Center, White Oak, Md.

THERMODYNAMIC AND MELTING PROPERTIES OF RDX AT ELEVATED PRESSURES

Dorn W. Carlson, G. W. Nauflett, J. W. Brasch, Sr., and T. D. Austin *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 527-536 refs (For primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The laboratory set up for determination of melting and thermodynamic properties of RDX using a diamond anvil cell apparatus capable of pressures exceeding 10 kbar and 250 C is described. The slope of the melting temperature versus applied pressure curve for RDX, as determined in the diamond cell, was found to equal 4.09 + or - 0.6 C (kbar). The density of liquid RDX at its melting point was calculated from this slope to be approximately 1.63 gm/cu cm. Practical and theoretical considerations in using the diamond anvil cell to generate thermodynamic data on RDX are discussed. Author

N81-16307* Army Armament Research and Development Command, Dover, N. J.

DEVELOPMENT OF A SOLVENT PROCESSED INSENSITIVE PROPELLANT

R. Trask, E. Costa, and A. J. Beardell *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 537-546 refs (For primary document see N81-16288 07-28)

Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Two types of low vulnerability propellants are studied which are distinguished by whether the binder is a rubber, such as polyurethane or CTBN, or a plasticizable polymer such as ethyl cellulose or cellulose acetate. The former propellants are made by a partial cure extrusion process while the latter are made by the conventional solvent process. Emphasis is given to a cellulose binder (plasticizer) RDX composition. The type of binder used, the particle size of the RDX and the presence of small quantities of nitrocellulose in the solvent processed compositions have important influences on the mechanical and combustion characteristics of the propellant. The low temperature combustion is of particular concern because of potential breakup of the grains that can lead to instability. R.C.T.

N81-16308* Naval Ordnance Station, Indian Head, Md.
NAVY LOVA PROPELLANT DEVELOPMENT
Wayne H. Vreatt and Stephen E. Mitchell *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 547-556 ref (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The progress realized on evaluation of inert binder, nitramine formulations is considered with respect to their development for use as low vulnerability ammunition (LOVA) propellants. Burning rate, plasticizers, crosslink agents, physical property and vulnerability studies are discussed and some preliminary conclusions presented. R.C.T.

N81-16309* Naval Weapons Center, China Lake, Calif. Aerothermochemistry Div.
SELF-DEFLAGRATION RATES OF 1,3,5-TRIAMINO-2,4,6-TRINITROBENZENE (TATB)
T. L. Boggs, C. F. Price, D. E. Zurn, A. I. Atwood, and J. L. Eisel *In* NASA. Langley Res. Center The 17th JANNAF Combust. Meeting, Vol. 2, Nov. 1980 p 557-558 refs (For primary document see N81-16288 07-28)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The thermal stability and resistance to impact was investigated for the ingredient TABA. Particular attention was given to determining the use of TABA as a possible alternative ingredient or substitute for HMX in explosives and high energy propellants. The burn rate of TABA was investigated as a function of pressure. It was concluded that the self deflagration rate of TABA is an order of magnitude lower than HMX over the range 2000-15000 psi; TABA will not sustain self deflagration at low pressures (less than or equal to 1500 psi) in the sample configuration and apparatus used. R.C.T.

N81-16310*# Aerojet Liquid Rocket Co., Sacramento, Calif.
PHOTOGRAPHIC COMBUSTION CHARACTERIZATION OF LOX/HYDROCARBON TYPE PROPELLANTS Final Report
D. C. Judd 15 Aug. 1980 164 p refs Original contains color illustrations
(Contract NAS9-15724)
(NASA-CR-160906; MA-129T) Avail: NTIS HC A08/MF A01 CSCL 21D

The advantages and limitations of using high speed photography to identify potential combustion anomalies (pops, fuel freezing, reactive stream separation (RSS), carbon formation) were demonstrated. Combustion evaluation criteria were developed for evaluating, characterizing, and screening promising low cost propellant combination(s) and injector element(s) for long life, reusable engine systems. Carbon formation and RSS mechanisms and trends were identified by using high speed color photography at speeds up to 6000 frames/sec. Single element injectors were tested with LOX/RP-1, LOX/Propane, LOX/Methane and LOX/Ammonia propellants. Tests were conducted using seven separate injector elements. Five different conventionally machined elements were tested: OFO Triplet; Rectangular Unlike Doublet (RUD); Unlike Doublet (UD); Like on Lke Doublet (LOL-EDM); and Slit Triplet. T.M.

N81-16311# Committee on Energy and Natural Resources (U.S. Senate).
OCTOBER REPORT ON THE CURRENT FUEL SITUATION FROM THE ENERGY INFORMATION ADMINISTRATION
Washington GPO 1980 220 p refs Hearing before the Subcomm. on Energy Regulation of the Comm. on Energy and Nat. Resources, 96th Congr., 1st Sess., 22 Oct. 1979
(GPO-60-871; Publ-96-101) Avail: Subcommittee on Energy Regulation

The energy situation is assessed with emphasis on the near term supply of petroleum fuels and prevailing prices. The effect of immediate decontrol of gasoline prices is considered as well as the profits of refineries since price controls were life lifted from heating oil and diesel fuels. A.R.H.

N81-16312# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMLENTAL STUDY OF SOLID PROPELLANT DEFLAGRATION USING HIGH SPEED MOTION PICTURES AND POSTFIRE RESIDUE ANALYSIS M.S. Thesis
Vincent Daniel DiLoreto Jun. 1980 111 p refs
(RR0000110)
(AD-A092423) Avail: NTIS HC A06/MF A01 CSCL 21/9

Six aluminized propellants were investigated through strand burning in a windowed combustion bomb at 500 psi and 1000 psi. Postfire particle residues were analyzed with a scanning electron microscope and found to have bi-modal size distributions. The mean diameter of the fine particle distribution was approximately 10 microns in all cases while the mean diameter of the coarse particles was approximately the same size as the initial aluminum cast in the propellant. Measurements taken from the high speed motion pictures included resolution, propellant burning rate, the diameter of the burning particles ejected from the surface, and vertical burning particles. The diameters of burning particles were approximately 7 to 12 times the diameter of the initial aluminum cast in the propellant. Aluminum size had only small effects on burning rate. The smallest particle that could be accurately resolved with the motion pictures was approximately 60 microns. GRA

N81-16313# Space Sciences, Inc., Monrovia, Calif.
A MASS-SPECTROMETRIC INVESTIGATION OF CHEMICAL ASPECTS OF SEVERAL ENERGETIC PROPELLANTS AND EXPLOSIVES Final Report, 1 May 1975 - 1 Aug. 1980
Milton Farber and R. D. Srijastava 30 Sep. 1980 74 p refs
(Contract N00014-75-C-0986)
(AD-A092148) Avail: NTIS HC A04/MF A01 CSCL 07/4

During the course of the contract chemical aspects of several propellants and explosives were investigated. Employing mass spectrometer species identification, combustion, decomposition kinetic and ignition experiments were performed to determine the mechanisms and reactions of several energetic materials. Four general categories of compounds were involved: (1) super rate and plateau burning propellants, (2) advanced gun propellant candidates, (3) the propellant and explosive compounds, 1,3,5-trinitrohexahydro-1,3,5-triazine (RDX), 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX), and 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), and (4) a new series of high nitrogen binder materials. GRA

N81-16314# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
ENVIRONMETRICS OF SYNFUELS. 1: PROCESSING THE AUTOMATED PDP-11 DATA COMPONENTS FOR THE UMD GASIFIER FACILITY
R. H. Strand, M. P. Farrell, C. W. Gudmundson, T. K. Birchfield, S. S. Casada, and M. E. Vansuch 1980 19 p
(Contract W-7405-eng-26)
(CONF-8010106-7; Publ-1564) Avail: NTIS HC A02/MF A01.

Techniques and procedures used to handle automated data collected at the University of Minnesota-Duluth campus coal gasification facility are described. This facility is evaluated for its potential health and environmental effects. Automatic and manually collected data and sample results data are used for this assessment. The procedures developed within the data management project for handling two categories of automated data are described: (1) process; and (2) environmental. The examples use data from the first one and a half years of gasifier operation. S.F.

N81-16315# Oak Ridge National Lab., Tenn. Environmental Sciences Div.
ENVIRONMETRICS OF SYNFUELS. II: A COMPUTER-BASED CODING SCHEME FOR COAL-CONVERSION RESEARCH DATA
R. H. Strand, M. P. Farrell, T. K. Birchfield, C. W. Gudmundson, M. E. Vansuch, and H. N. Polovino 1980 15 p refs
(Contract W-7405-eng-26)
(CONF-8010106-3; Publ-1602) Avail: NTIS HC A02/MF A01

The need to reduce the complexity of data encoding and error rates in studies using multiple data bases composed of hierarchical file structures is discussed. A coding scheme to represent long alphanumeric values is discribed. The efficiency of such a scheme is indicated and error-rate reduction is discussed. Several approaches are available that minimize coding errors. Numeric codes with embedded information allocated to positions within the value codes are widely used, but these are unacceptable

for variables with many values or levels of classification. Such numeric smart codes require the full knowledge of the universe the variables describe, as well as the potential classification schemes for each variable. Codes without embedded information (nonsense codes) circumvent the problems associated with smart codes. With nonsense codes, alphanumeric variable values are assigned a sequential numeric code as new values are encountered in the data base, irrespective of their value in the alphanumeric sequence. S.F.

N81-16316# Mid-American Solar Energy Complex, Minneapolis, Minn.

ON-FARM PRODUCTION OF FUEL-ALCOHOL IN MID-AMERICA TECHNICAL AND ECONOMIC POTENTIAL

Michael A. Hohmann Mar. 1980 22 p refs Presented at the 12th Ann. Meeting of the Mid-Continent Regional Sci. Assoc., Lincoln, Nebr., 24-26 Apr. 1980

(Contract DE-AC02-79CS-30150)

(MASEC-TP-80-009; CONF-8004124-1) Avail: NTIS HC A02/MF A01

The agricultural energy consumption for the central part of the United States was examined. Fermentation alcohol production and co product usage rates were predicted. Theoretical ethanol yields from raw materials are presented. Suggestions for further research and development in farm fuel production are presented. T.M.

N81-16317# Argonne National Lab., Ill. Chemical Engineering Div.

SAMPLING AND INSTRUMENTATION FOR FLUIDIZED-BED COMBUSTION Annual Report, Oct. 1978 - Sep. 1979

Irving Johnson, W. F. Posolski, K. M. Myles, K. E. Griggs (Fluor Power Services, Chicago), A. A. Siczek, W. W. Managan, R. W. Doering, J. J. Eichholz, N. M. Fallon, and C. L. Herzenberg Sep. 1980 109 p refs

(Contract W-31-109-eng-38)

(ANL/CEN/FE-80-2) Avail: NTIS HC A06/MF A01

Background information is presented on process control, scientific investigation, and safety, in planned and operating fluidized bed combustion systems. Two prototype mass flow rate instruments installed on the solids feed lines of an existing ANL fluidized bed combustor are described. Each instrument consisted of a capacitive sensor spoolpiece and an associated preamplifier and signal conditioning. One channel of each instrument provides three outputs. One delivers a density signal while two others deliver two signals for measuring velocity by cross correlation. Operation was verified by using laboratory signal analyzers to process the signals. Analytical techniques suitable for monitoring the concentration of gaseous alkali compounds in the hot gas stream from a fluidized bed combustor are described. T.M.

N81-16318# Gulf Research and Development Co., Pittsburgh, Pa.

INVESTIGATION OF MECHANISM OF HYDROGEN TRANSFER IN COAL HYDROGENATION Quarterly Progress Report, Jun. - Aug. 1980

D. C. Cronauer, R. G. Ruberto, R. McNeil, and D.C. Young Sep. 1980 25 p refs

(Contract DE-AC22-80PC-30080)

(DOE/PC-30080-T2) Avail: NTIS HC A02/MF A01

Transfer experiments using bituminous coal and deuterium labeled tetralin and described. The rate of coal conversion, hydrogen transfer and site of hydrogen transfer were measured. Results showed that about 3.5 g of hydrogen is transferred per 1000 g MAF coal at reactor conditions of 450 C, 30 minute and 30% feed coal in tetralin. At these conditions, about 73% conversion of coal to toluene solubles was achieved. Results at lower times (0 and 10 minutes) and temperatures (300, 350, and 400 C) are also discussed. An evaluation of the techniques of measure hydrogen donor capacity indicated that the best instrumental approach available to us is that in which NMR is used to quantify the level of hydroaromatics. Both GC/MS and group type MS techniques do not appear to be adequate for this purpose. T.M.

N81-16319# California Univ., Livermore. Lawrence Livermore Lab.

SOME ANALYTICAL METHODS FOR EXPLOSIVES AND OTHER ORGANIC MATERIALS, PART 6

W. Selig, ed. 16 Jun. 1980 119 p refs Sponsored by DOE

(UCRL-7873-Pt-6) Avail: NTIS HC A06/MF A01

The techniques described include various forms of photometry and chromatography, MNR, extraction, and aqueous and non aqueous titration. Materials investigated included TATB, nitrobenzene, guanidine nitrate, and HMX/KP/Estane composites. T.M.

N81-16320# National Coal Board, Stoke Orchard (England). Coal Combustion Systems Div.

MATERIALS PROBLEMS IN FLUIDIZED-BED COMBUSTION SYSTEMS Final Report

John Stringer May 1980 113 p refs Sponsored by EPRI

(EPRI Proj. 388-1)

(EPRI-CS-1449) Avail: NTIS HC A06/MF A01

The corrosion of a wide range of candidate structural materials was studied in a variety of fluidized bed combustion environments for relatively long exposure times. A 12 inch square atmospheric pressure fbc was employed and a total of 38 alloys were tested at various temperatures in above bed, in bed and exit cyclone conditions, for exposures of 1000 and 2000 hours. The most severe corrosion observed was of the in bed specimens and it appeared to be of the sulfidation/oxidation type. Nickel base alloys were rather more susceptible to the form of corrosion than either the iron or cobalt base systems. The austenitic stainless steels appeared to perform relatively well up to metal temperatures of 650 C; but further work is required before any materials could be recommended for higher temperature applications at high stresses. For support member applications (at bed temperature but under relatively low stresses), the iron based alloy GE2541 appeared best. E.D.K.

N81-16321# Foster Wheeler Corp., Livingston, N.J. John Blizzard Research Center.

MATERIALS PROBLEMS IN FLUIDIZED-BED COMBUSTION SYSTEMS. APPENDIX 3: EVALUATION OF BOILER ALLOY SPECIMENS AT FOSTER WHEELER DEVELOPMENT CORPORATION Final Report

G. V. Amoruso and W. R. Apblett, Jr. May 1980 289 p refs

(EPRI Proj. 388-1)

(EPRI-CS-1449-App-3) Avail: NTIS HC A13/MF A01

The results of a metallurgical investigation conducted to assess the corrosion behavior of various ferritic, austenitic and nickel base alloys which were exposed in a coal burning fluidized bed test facility at nominal temperatures of 1000 F, 1200 F, 1400 F, 1550 F and 1650 F for 1000 and 2000 hour test exposure periods are summarized. The alloys included Corten, 2-1/4Cr-1Mo, 9Cr-1Mo, 405 SS, E-Brite 26-1, 310 SS, 329 SS, 347 SS, 22-13-5, 21-6-9, Incoloy 800, Manaurite 36X, Inconel 690 and RA 333. The investigation included material precharacterization studies and post test metallurgical evaluations involving deposit/scale thickness measurements, selective chemical/microprobe analyses, specimen surface recession measurements, determination of depths of dealloying and corrosive constituent penetrations, grain size determinations, harness surveys, macro and microscopic examinations and study/recording of microstructural changes resulting as a consequence of test exposure. T.M.

N81-16322# Oak Ridge National Lab., Tenn. Chemical Technology Div.

RESOURCE RECOVERY FROM COAL RESIDUES

G. Jones, Jr. 1980 12 p refs Presented at 73rd Ann. Meeting of the Am. Inst. Chem. Engr., Chicago, 16-20 Nov. 1980

(Contract W-7405-eng-26)

(CONF-801104-8) Avail: NTIS HC A02/MF A01

Several processes are being developed to recover metals from coal combustion and conversion residues. Methods to obtain substantial amounts of aluminum, iron, and titanium from these wastes are presented. Author

N81-16323# Institute of Gas Technology, Chicago, Ill.

STUDY OF THE BEHAVIOR OF GAS DISTRIBUTION EQUIPMENTS IN HYDROGEN SERVICE, PHASE 2

Walter J. Jasinowski and H. Ding Huang 1980 7 p refs Presented at DOE Advan. Conserv. Technol. and Chem. Storage Branch Contract Rev. Meeting, McLean, Va., 13-16, Oct. 1980 Sponsored by DOE

(CONF-801055-5) Avail: NTIS HC A02/MF A01

The characteristics of gas distribution pipe in hydrogen service were studied. In experiments with three types of commercially availabe polyethylene natural gas piping, hydrogen permeation was found to be 4 to 6 times greater than methane permeation. Ring tensile tests showed no significant difference in apparent strength of exposed and as received pipe samples, although the exposed specimens show greater elongation after testing to failure. Leakage experiments with methane hydrogen blends showed no selective leakage of hydrogen via Poisenille, turbulent or orifice flow through leaks. Leak rates increased with increasing pressure and decreasing specific gravity. R.C.T.

N81-16324# Dynecology, Inc., Harrison, N.Y.

ENERGY FROM BIOMASS: THE SIMPLEX PROCESS FOR THE GASIFICATION OF COAL AND FOREST PULP Final Report, Jan. 1979 - Mar. 1980

John C. Arbo and David P. Glaser Apr. 1980 103 p Sponsored by New York State Energy Research and Development Authority

(PB81-110512; NYSERDA-80-2) Avail: NTIS HC A06/MF A01 CSCL 21D

A series of tests were performed to investigate the adaptation of simplex process to the gasification of forest pulp or wood wastes. A coal and forest pulp briquette formulation, needed for the gasification process, was developed as part of the project. The sample briquettes were successfully turned into gas. GRA

N81-16325*# New Mexico Univ., Albuquerque. Technology Application Center.

HYDROGEN STORAGE AS A HYDRIDE. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1975 - Jul. 1980

Gerald F. Zollars Sep. 1980 80 p Supersedes NTIS/PS-79/0772/8 Sponsored in cooperation with NASA and NTIS

(NASA-CR-163914; PB80-815830; NTIS/PS-79/0772/8) Avail: NTIS HC $30.00/MF $30.00 CSCL 21D

These citations from the international literature concern the storage of hydrogen in various metal hydrides. Binary and intermetallic hydrides are considered. Specific alloys discussed are iron titanium, lanthanium nickel, magnesium copper and magnesium nickel among others. GRA

N81-16326# National Technical Information Service, Springfield, Va.

ALCOHOL FUELS. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1973 - Jul. 1980

Diane M. Cavagnaro Oct. 1980 266 p Supersedes NTIS/PS-79/0911

(PB81-800096) Avail: NTIS HC $30.00/MF $30.00 CSCL 21D

Research on alcohol fuels is cited. The citations cover synthesis, chemical analysis, performance testing, processing, pollution, economics, environmental effects and feasibility. This updated bibliography contains 260 citations, 82 of which are new entries to the previous edition. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N81-16327*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TEXTURING POLYMER SURFACES BY TRANSFER CASTING Patent Application

Bruce A. Banks, Albert J. Weigand, and James S. Sovey, inventors (to NASA) Filed 19 Dec. 1980 7 p

(NASA-Case-LEW-13120-1; US-Patent-Appl-SN-218587) Avail: NTIS HC A02/MF A01 CSCL 13H

A surface of a fluorocarbon polymer is exposed to a beam of ions from a source to texture it. The polymer which is to be surface roughened is then cast over the textured surface of the fluorocarbon polymer. After curing, the cast polymer is peeled off the textured fluorocarbon polymer and the peeled off surface has a negative replica of the textured surface. The microscopic surface texture provides large surface areas for adhesive bonding. In cardiovascular prosthesis applications the surfaces are relied on for the development of a thin adherent well nourished thrombus. NASA

N81-16328*# National Aeronautics and Space Administration. Pasadena Office, Calif.

METHOD OF FORMING FROZEN SPHERES IN A FORCE-FREE DROP TOWER Patent Application

James M. Kendall, Jr., inventor (to NASA) (JPL) Filed 24 Dec. 1980 11 p

(Contract NAS7-100)

(NASA-Case-NPO-14845-1; US-Patent-Appl-SN-215680) Avail: NTIS HC A02/MF A01 CSCL 13H

A technique is disclosed for uniformly shaping hollow glass spheres by the effects of surface tension acting on bubbles of glass in its molten state. The method is characterized by the steps of establishing a downwardly flowing stream of air accelerated at a one-G rate of acceleration through a drop tower, introducing into the stream of air free-falling bubbles of molten glass, and freezing the bubbles in the stream as they are accelerated at a one-G rate of acceleration. NASA

N81-16329*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MECHANICAL BONDING OF METAL Patent Application

Bruce A. Banks, inventor (to NASA) Filed 26 Nov. 1980 8 p

(NASA-Case-LEW-12941-1; US-Patent-Appl-SN-210632) Avail: NTIS HC A02/MF A01 CSCL 13H

The metal surfaces of the structures that are to be bonded are exposed to an ion beam together with a target of low sputtering yield material. This material deposits on the surfaces and creates sites of sputter resistance which evolve into peaks of a conelike surface microstructure. The textured metal surfaces are arranged in face-to-face relationship and compressed together with plastic deformation which mechanically interlocks the cone. A large interface area is produced which minimizes thermal and electrical losses. Also, no electrical power or heat is required during metal joining. The process can be performed in either air or vacuum. NASA

N81-16330# Combustion Engineering, Inc., Chattanooga, Tenn. Chattanooga Nuclear Operations.

THERMAL-HYDRAULIC CHARACTERISTICS OF A COMBUSTION ENGINEERING SYSTEM 80 STEAM GENERATOR. VOLUME 2: APPENDIX A Interim Report

R. W. Fanselau, J. G. Thakkar, J. W. Hiestand, and D. S. Cassell Sep. 1980 273 p

(EPRI Proj. 129-1)

(EPRI-NP-1528-Vol-2) Avail: NTIS HC A12/MF A01

The steady state thermal hydraulic characteristics on the secondary side of a combustion engineering system 80 steam generator are presented. Details of the CALIPSOS model with accompanying assumptions, operating parameters, and transport correlations are identified. Comprehensive graphical and numerical results are presented to facilitate the desired comparison with other steam generators analyzed by the same flow distribution code. R.C.T.

N81-16331# Colorado Div. of Highways, Denver. Materials Lab.

HIGH ALTITUDE PREMIUM PAVEMENTS Final Report

Frank Abel and Joe Proctor Feb. 1980 73 p Prepared in cooperation with Federal Highway Administration, Washington, D.C.

(PB81-100448; CDOH-SMB-R-80-4; FHWA-CO-RD-80-4) Avail: NTIS HC A04/MF A01 CSCL 13C

The effect on performance that various additives and, or compaction had on the performance of pavements was evaluated. The following additives were evaluated: Anti-stripping additives, ground scrap rubber and carbon black. Samples were also evaluated at approximately 0, 3, 10 and 15% voids to determine the effect compaction had on the performance of the pavement. The resilient modulus, effect of water on cohesion of compacted bituminous mixtures and an accelerated moisture damage test was performed on each design mix. Most of the additives did not show significant, if any, improvement in the

laboratory test results. The best improvement in laboratory test results came from the anti-stripping asphalt additives, which is one of the least costly and simplest to include in the pavement mixture. GRA

N81-16332# Espey-Houston and Associates, Inc., Albuquerque, N. Mex.
POROUS PAVEMENT. PHASE 1: DESIGN AND OPERATIONAL CRITERIA Final Report, 1 Feb. - Aug. 1979
Elvidio V. Diniz Aug. 1980 100 p refs Prepared in cooperation with City of Austin, Tex.
(Grant EPA-R-806338)
(PB81-104796; EPA-600/2-80-135) Avail: NTIS HC A05/MF A01 CSCL 13B

Utilization concepts, benefits and disadvantages, as well as other characteristics of porous pavements are presented with emphasis on porous asphalt pavements, but the criteria and design approach are applicable to all other porous pavement types. Design considerations include siting problems, load bearing design and hydrologic design. The history of porous pavement development and previous experience with porous pavement by several designers, contractors and operators are described. A computer model for hydrologic performance evaluation of existing or proposed porous pavement systems is also examined. Load bearing design criteria are based on previous work conducted for porous asphalt pavements. Appendices include a sample set of specifications for porous asphalt construction and a list of soils and their permeability classes as prepared by the U.S. Soil Conservation Service. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N81-16333 Ohio State Univ., Columbus.
THE ELECTROMAGNETIC PROPERTIES OF SMALL METAL PARTICLE MIXTURES Ph.D. Thesis
Richard Lee Henry 1980 314 p
Avail: Univ. Microfilms Order No. 8100166

The far infrared absorption coefficient of mixtures of small metal and insulating particles is addressed. The absorption coefficients of samples containing gold and palladium in an alumina host were measured from 5 to 150/cm. The palladium samples were then converted into PdH0.8 so that the electrical conductivity of the metal could be changed without affecting the geometric arrangement of the particles. The absorption coefficients of the hydrogenated palladium samples were compared with their unhydrogenated counterparts. Scanning electron micrographs revealed that the particles were aggregated into clusters. The theoretical calculations used the effective medium theory to find the conductivity of these clusters. The absorption coefficients of the mixtures were calculated from the effective dielectric function and the effective magnetic permeability. These quantities were obtained with the Maxwell Garnett approach. The electric and magnetic polarizabilities were calculated from Mie theory. The cluster size distributions were accounted for explicitly in the calculations. The absorption is strongly dependent on the geometric arrangement of the particles in the mixtures and only weakly on the electrical conductivity of the particles themselves. Dissert. Abstr.

N81-16334 Princeton Univ., N. J.
PONDEROMOTIVE FORCE EFFECTS ON RESONANCE CONES AND SLOW WAVE COUPLING ABOVE THE LOWER HYBRID FREQUENCY Ph.D. Thesis
James Randall Wilson 1980 141 p
Avail: Univ. Microfilms Order No. 8101562

The nonlinear ponderomotive force effects on resonance cones and slow waves above the lower hybrid frequency were investigated. The rf fields were launched from a multiring electrostatic antenna. Suitable phasing of the rings allowed slow waves to be excited. The experiments were performed in the Princeton L-3 linear device, which has the following plasma parameters: solenoidal magnetic field B sub 0 less than or equal to 1.8 kG; plasma density n sub 0 = 10 to the 9th power - 5 x 10 to the 10th power/cu cm; electron temperature T sub e is equal to 0.5 - 3 eV; ion temperature T sub i < 0.1 eV; neutral pressure P sub 0 is equal to 10 to the minus 5th power - 3 x 10 to the minus 4th power Torr in He, Ne, Ar and Kr. Dissert. Abstr.

N81-16335 North Texas State Univ., Denton.
PHASE TRANSITION STUDIES IN POLAR AND NONPOLAR LIQUIDS AT MICROWAVE FREQUENCIES Ph.D. Thesis
Jai Narain Dahiya 1980 117 p
Avail: Univ. Microfilms Order No. 8028998

A resonant microwave cavity technique was employed to study the dielectric behavior of some polar and nonpolar liquids near the phase transition temperatures at microwave frequencies 7.2, 9.2 and 10.1 GHz. The Slater perturbation equations for a resonant microwave cavity are briefly discussed to show that the above technique can be used to determine both the real and imaginary parts of dielectric response. Abrupt changes in dielectric response were observed near the phase transition temperatures for the polar liquids studied. Dissert. Abstr.

N81-16336 Saint Louis Univ., Mo.
RAYLEIGH WAVE PROPAGATION AND ATTENUATION ACROSS THE ATLANTIC OCEAN Ph.D. Thesis
Jose Antonio Canas 1980 254 p
Avail: Univ. Microfilms Order No. 8100481

Fundamental mode Rayleigh waves generated by several earthquakes situated along great circle paths between pairs of seismograph stations on the American and European coastal regions and on Atlantic islands were analyzed to obtain anelastic attenuation coefficients group and phase velocities, azimuthal anisotropy coefficients, and specific quality factors of Rayleigh waves. Inversion of the dispersion and attenuation data yield shear velocity models and shear wave internal friction models for several regions of different age in the Atlantic Ocean. Synthetic seismograms are used to further investigate the nature of anelastic attenuation in the northern part of the Atlantic Ocean. Significant results are reported. Dissert. Abstr.

N81-16337 British Broadcasting Corp., Kingswood (England). Dept. of Research.
COLOUR OPERATION OF A SOLID STATE SENSOR TELECINE
I. Childs Nov. 1980 24 p refs
(BBC-RD-1980/11) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A color film scanner was constructed using solid state charge coupled device image sensors. The scanner gave improved reliability ease of maintenance together with good picture quality. Various technical aspects of performance were examined. It is concluded that the picture quality is in most respects at least as good as that of a flying spot scanner. One possible exception is the noise level, which is marginal; however, foreseeable improvements in solid state sensor design should overcome this problem. R.C.T.

N81-16338*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RECEIVING AND TRACKING PHASE MODULATED SIGNALS Patent Application
Salvador Villarreal, Stuart Donald Lenett, and Herbert S. Kobayashi, inventors (to NASA) Filed 7 May 1980 14 p
(NASA-Case-MSC-16170-2; US-Patent-Appl-SN-147695) Avail: NTIS HC A02/MF A01 CSCL 17B

An apparatus and technique are described for receiving and tracking analog or digital phase modulated signals from 0 deg to 360 deg phase shift. In order to track a signal with many phases, a detector discerns the phase modulation of the incoming signal and a phase shifter generates a negative phase shift opposite in angle to the detected phase angle. This produces a converted series sideband component barrier signal. The residual carrier signal and the converted series sideband component carrier are added together to produce a tracking carrier signal. The tracking carrier signal is multiplied with the output from a voltage controlled oscillator in the tracking loop to obtain an error signal

which drives the voltage controlled oscillator and tracks the incoming signal frequency. The technique is less susceptible to carrier interference which may degrade tracking and tracking may be performed at lower signal-to-noise ratios and for lower input signal power levels. NASA

N81-16339*# Stanford Univ., Calif. Dept. of Engineering-Economic Systems.

ALTERNATIVE LICENSING ARRANGEMENTS AND SPECTRUM ECONOMICS: THE CASE OF MULTIPOINT DISTRIBUTION SERVICE

Carson E. Agnew Jan. 1981 51 p refs
(Contract NASw-3204)
(NASA-CR-163922; SU-31) Avail: NTIS HC A04/MF A01 CSCL 17B

At present, the Federal Communications Commission assigns radio licenses following a determination of the public interest. Whenever mutually conflicting license applications are filed, the Commission holds a comparative hearing. This assignment mechanism is criticized as cumbersome and unrealiable, and three alternatives are proposed: increasing the available spectrum, and either auctions or lotteries of radio licenses. An analysis is presented of the present system and these alternative arrangments for assigning rights to the frequency spectrum for the Multipoint Distribution Service (MDS). Although MDS is a relatively minor radio service, it serves as a prototype for message distribution services with a large potential for use in business communications. Moreover, the way in which the initial batch of MDS licenses was assigned provides a unique opportunity for empirical work on the economics of the licensing process. E.D.K.

N81-16340*# City Coll. of the City Univ. of New York. Communication Systems Lab.

BANDWIDTH COMPRESSION OF COLOR VIDEO SIGNALS Ph.D. Thesis Final Report, 1 Oct. 1979 - 30 Sep. 1980

Donald L. Schilling 1980 57 p refs
(Grant NsG-5013)
(NASA-CR-163872) Avail: NTIS HC A04/MF A01 CSCL 09F

The different encoder/decoder strategies to digitally encode video using an adaptive delta modulation are described. The techniques employed are: (1) separately encoding the R, G, and B components; (2) separately encoding the I, Y, and Q components; and (3) encoding the picture in a line sequential manner. R.C.T.

N81-16341*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ON THE POWER SPECTRAL DENSITY OF QUADRATURE MODULATED SIGNALS

T. Y. Yan 15 Jan. 1981 34 p refs
(Contract NAS7-100)
(JPL-Pub-80-95) Avail: NTIS HC A03/MF A01 CSCL 17B

The conventional (no-offset) quadriphase modulation technique suffers from the fact that hardlimiting will restore the frequency sidelobes removed by proper filtering. Thus, offset keyed quadriphase modulation techniques are often proposed for satellite communication with bandpass hardlimiting. A unified theory is developed which is capable of describing the power spectral density before and after the hardlimiting process. Using the in-phase and the quadrature phase channel with arbitrary pulse shaping, analytical results are established for generalized quadriphase modulation. In particular MSK, OPSK or the recently introduced overlapped raised cosine keying all fall into this general category. It is shown that for a linear communication channel, the power spectral density of the modulated signal remains unchanged regardless of the offset delay. Furthermore, if the in phase and the quadrature phase channel have identical pulse shapes without offset, the spectrum after bandpass hardlimiting will be identical to that of the conventional QPSK modulation. Numerical examples are given for various modulation techniques. A case of different pulse shapes in the in phase and the quadrature phase channel is also considered. Author

N81-16342# General Electric Co., Syracuse, N.Y. Military Electronic Systems Operation.

DESIGN OF BROADSIDE ARRAYS USING ITERATIVE INTERPOLATION TECHNIQUES

John P. Costas Sep. 1980 87 p refs
(AD-A092800; R80EMH6) Avail: NTIS HC A05/MF A01 CSCL 20/14

Arrays having specified beamwidths and sidelobe levels may be synthesized from a simple 'seed' array having the required sidelobe level, but a much broader beamwidth than the specification value. An iterative process doubles array spacing at each step. This narrows the main beam by a direct scaling factor of two in sin theta space. The echelon lobes introduced by this action are reduced to the specification sidelobe level values by an interpolation procedure which introduces appropriate element weights at the vacated positions. This 'stretch and fill' tactic may be used repeatedly to obtain any beamwidth desired. The computations of weights for these arrays of any size are trivial and the resulting current distributions have a well-behaved taper. Aperture size requirements and efficiencies are consistent with those of conventional designs for a given beamwidth and sidelobe combination. Supergaining problems are not encountered with this procedure. Interpolation techniques are also used to develop a unique aperture format and excitation matrix combination. This approach to beam steering provides for control of pointing angle through signal level control as opposed to the conventional use of phase shifters for steering. GRA

N81-16343# IIT Research Inst., Chicago, Ill.

EVALUATION OF TIME DOMAIN EM COUPLING TECHNIQUES, VOLUME 1 Final Technical Report, 7 Dec. 1978 - 29 Feb. 1980

Allen Taflove Griffiss AFB, N.Y. RADC Aug. 1980 177 p refs 2 Vol.
(Contracts F30602-79-C-0039; F30602-77-C-0163; AF Proj. 2338)
(AD-A092031; RADC-TR-80-251-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 20/14

This research program investigated a new tool for the analysis of electromagnetic coupling and shielding problems: the finite-difference, time-domain (FD-TD) solution of Maxwell's equations. The objective of the program was to evaluate the suitability of the FD-TD method to determine the amount of electromagnetic coupling through an aperture into an enclosed conducting container and the interaction and coupling of the penetrating field with internal electronics. Two specific container models were used for the evaluation. The first, a conducting cylinder with one open end; the other, the guidance section of a missile. Each of these two configurations was modeled to calculate the electromagnetic field coupled into the structure. GRA

N81-16344# IIT Research Inst., Chicago, Ill.

EVALUATION OF TIME DOMAIN EM COUPLING TECHNIQUES, VOLUME 2 Final Technical Report, 7 Dec. 1978 - 29 Feb. 1980

Allen Taflove Griffiss AFB, N.Y. RADC Aug. 1980 99 p refs 2 Vol.
(Contract F30602-79-C-0039; AF Proj. 2338)
(AD-A092032; RADC-TR-80-251-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 20/14

This research program investigated a new tool for the analysis of electromagnetic coupling and shielding problems: the finite-difference, time-domain (FD-TD) solution of Maxwell's equations. The objective of the program was to evaluate the suitability of the FD-TD method to determine the amount of electromagnetic coupling through an aperture into an enclosed conducting container and the interaction and coupling of the penetrating fields with internal electronics. Two specific container models were used for the evaluation. The first, a conducting cylinder with one open end; and the other, the guidance section of a missile. Each of these two configurations was modeled to calculate the electromagnetic field coupled into the structure. GRA

N81-16345# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

CIRCULARLY POLARIZED MEASUREMENTS OF RADAR BACKSCATTER FROM TERRAIN AND SNOW-COVERED TERRAIN Final Report

W. H. Stiles, Fawwaz T. Ulaby, E. A. Wilson, and J. C. Holtzman Jul. 1980 148 p refs
(Contract DAAK70-78-C-0121)
(AD-A092077; CRINC/RSL-TR-393-2; ETL-0234) Avail: NTIS

HC A07/MF A01 CSCL 17/9

This report covers a measurement program to obtain circularly polarized radar backscatter coefficient data along with associated ground-truth information on snow-covered terrain. Snow-covered grass, asphalt and ice were observed at selected frequencies from 8 to 18 GHz for angles of incidence 0 deg (nadir) and 80 deg. Also included are some analyses of the effects of snowcover on the backscatter from terrain. GRA

N81-16346# Naval Research Lab., Washington, D. C. Communications Sciences Div.

PERFORMANCE OF ANDVT HF MODEM WITH PEAK CLIPPING Interim Report

Wayne M. Jewett and Raymond Cole, Jr. 30 Oct. 1980 27 p refs

(AD-A092114; NRL-MR-4374) Avail: NTIS HC A03/MF A01 CSCL 09/5

The performance of the signal design for the ANDVT hf modem was investigated for the Gaussian channel with variable amounts of peak clipping on the modulator output. The advantage is an increase in average power when operating in a peak power limiting situation. A recommendation is made for use of 8.0 dB of clipping on the 16 tone DPSK signal used for transmitting the message indicator and 9.5 dB of clipping on the 39 tone DPSK signal used for transmitting digital voice. GRA

N81-16347# Naval Postgraduate School, Monterey, Calif. Dept. of Physics and Chemistry.

MEASUREMENT OF PUMPED SUPERLUMINAL ELECTROMAGNETIC RADIATION M.S. Thesis

William More Decker and Joseph Paul Macklin Jun. 1980 66 p refs

(AD-A092306) Avail: NTIS HC A04/MF A01 CSCL 20/8

A new source of radiation has been postulated that occurs when a charged particle, moving with a velocity greater than the velocity of light in a medium, is caused to oscillate about its transverse beam line by means of a static, periodic magnetic or electric field or by means of an incident transverse wave. Experiments were conducted to measure this new source of electromagnetic shock radiation and compare it to Cerenkov radiation, a known source of electromagnetic shock radiation. The preliminary results agree with predictions of Schneider and Spitzer, but the present accuracy is not sufficient to rule out alternative theories. GRA

N81-16348# Naval Postgraduate School, Monterey, Calif.

EXPERIMENTAL STUDY OF CONTRAST UTILIZING A VIDICON M.S. Thesis

Richard William Havel Jun. 1980 62 p refs

(AD-A092407) Avail: NTIS HC A04/MF A01 CSCL 09/1

A commercial multi-purpose closed circuit television camera system with a vidicon image tube was studied to determine its capability for measurement of contrast and visibility. A single line of the scan from the camera video output was extracted and examined with an oscilloscope. A derivation of system response was made and a comparison performed with laboratory data. Calibration of the field of view, for one particular television pick-up tube, revealed nonuniformities making resolution of 2 percent contrast difficult. Useful resolution results are expected with improvement of the pick-up tube or with employment of digital processing techniques. GRA

N81-16349# National Communications System, Washington, D. C.

REVISED CCITT RECOMMENDATION X.25 1980 Final Report

Harold C. Folts Aug. 1980 159 p

(AD-A092394; NCS-TIB-80-5) Avail: NTIS HC A08/MF A01 CSCL 17/2

This report contains the final draft of CCITT Recommendation X.25 as approved February 1980. X.25 defines the interface procedures for connection of user terminals to Public Packet-Switched Data Networks. The report also provides the background and a summary of the revisions made for this new version of X. GRA

N81-16350# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

EVALUATION OF A METEOROLOGICAL AIRBORNE PULSE DOPPLER RADAR Final Report, Oct. 1977 - Jul. 1980

B. L. Trotter, R. G. Strauch, and C. L. Frush (National Center for Atmospheric Research, Boulder, Colo.) Jul. 1980 45 p (Contract DOT-FA78WAI-877)

(AD-A092276; FAA-RD-80-98) Avail: NTIS HC A03/MF A01 CSCL 17/9

An X-band airborne radar has been modified to provide a Doppler radar capability. The Doppler radar has been tested to prove the system concept usable. Tests were conducted at Norman, Oklahoma, from May 30 to June 9 of 1978 and in Miami, Florida, on December 1 through December 5, 1979. Optimally the tests would have used meteorological targets for measurement of radial velocities, however, most tests had to be conducted with chaff and ground returns. The tests did show that the airborne Doppler radar will measure velocities that are comparable to those measured by a ground based Doppler radar and those that can be computed by a high accuracy inertial navigation system. The error in the measured radial velocities, when compared to other sensors, is much less than the estimated RMS error of 2 meters/second. GRA

N81-16351# Rochester Inst. of Tech., N. Y. Dept. of Electrical Engineering.

EXTENSION OF PENCIL-OF-FUNCTIONS METHOD TO REVERSE-TIME PROCESSING WITH FIRST-ORDER DIGITAL FILTERS

Vijay K. Jain (Univ. of South Florida, Tampa), Tapan K. Sarkar, and Donald D. Weiner (Syracuse Univ., N.Y.) Aug. 1980 97 p refs

(Contract N00014-79-C-0598; RR0210101)

(AD-A092226; TR-80-4; TR-3) Avail: NTIS HC A05/MF A01 CSCL 09/3

In this presentation, the data signal is processed in reverse-time by a cascade of first order digital filters to yield a family of information signals. The Gram matrix of these information signals is shown to contain the essential information on the poles of the signal. The entire procedure of the application of pencil-of-function method is thus noniterative. Examples presented demonstrate (1) noiseworthiness in the representation problem when data are corrupted by noise, and (2) the effectiveness of the method in the approximation problem. Comparison of the method with the maximum entropy method (or linear predictor) and the Prony method is also included. GRA

N81-16352# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical Engineering.

ANALYSIS OF A SIMULATED SOURCE OF ELECTROMAGNETIC PULSES M.S. Thesis - Arizona Univ.

Usto Francis Eugene Schulz Feb. 1980 62 p refs

(AD-A092440; AFIT-CI-80-4T) Avail: NTIS HC A04/MF A01 CSCL 20/14

This thesis describes an effort to develop a source of plane wave electromagnetic pulses for use in an experiment which was designed to measure the electromagnetic field strength across an axial slot in an infinite circular cylinder. Two approaches are described. One design approach attempted to simulate magnetic line source with an array of small current loops. The second approach attempted to simulate a magnetic line source with an array of long monopoles. It was concluded that a source of plane wave pulses could be constructed, but not without degradation in rise time. GRA

N81-16353# Harry Diamond Labs., Adelphi, Md.

UPGRADING THE AURORA SIMULATOR

Alexander G. Stewart Oct. 1980 42 p Sponsored by Defense Nuclear Agency

(AD-A092501; HDL-TM-80-28) Avail: NTIS HC A03/MF A01 CSCL 20/14

The necessary degree of control was acquired over those machine parameters that determine the bremsstrahlung dose output of the simulator, thereby improving the simulator efficiency and extending its range of applications. At a given charge voltage on the Marx generator, average dose output at the center of the test volume (TVC) was increased by about 20 percent, the peak dose output exceeded 50 krad (TVC) for the first time and reproducible low dose (50 rad) at low beam energy (4 MeV)

was established. One result of these improvements is that overall machine maintenance time has been reduced. GRA

N81-16354# Signatron, Inc., Lexington, Mass.
ADAPTIVE ANTENNA CONTROL (AAC) PROGRAM Test Report, Jul. 1977 - Oct. 1979
Peter Monsen and John Eschle Sep. 1980 320 p refs
(Contract DAAB01-76-C-8085; DA Proj. 1X7-63707-D-245) (AD-A092030; CSA-76-8085-6) Avail: NTIS HC A14/MF A01 CSCL 17/2

This is the test report for the Adaptive Antenna Control Program (Contract No. DAAB07-76-C-8085). The program is under the management of the U.S. Army Communications Systems Agency and monitored by the U.S. Army Communications R D Command both of Ft. Monmouth, New Jersey. SIGNATRON, Inc. and RF Systems, Inc. (as antenna sub-contractor) had the responsibility for executing the program tasks. This report summarizes these tasks and includes the results of the factory and field test phases. GRA

N81-16355# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INFORMATION PROCESSING TECHNIQUES PROGRAM. VOLUME 1: PACKET SPEECH SYSTEMS TECHNOLOGY Semiannual Technical Summary Report, 1 Oct. 1979 - 31 Mar. 1980
Clifford J. Weinstein and Peter E. Blankenship 31 Mar. 1980 45 p refs
(Contract F19628-80-C-0002; ARPA Order 3673) (AD-A092113; ESD-TR-80-71) Avail: NTIS HC A03/MF A01 CSCL 09/4

This report describes work performed on the Packet Speech Systems Technology Program sponsored by the Information Processing Techniques Office of the Defense Advanced Research Projects Agency during the period 1 October 1979 through 1 March 1980. GRA

N81-16356# Northeastern Univ., Boston, Mass.
SIGNAL PROCESSING CIRCUIT DEVELOPMENT Final Technical Report, 22 Dec. 1976 - 21 Dec. 1979
B. L. Cochrun Griffiss AFB, N.Y. RADC Sep. 1980 71 p refs
(Contract F19628-77-C-0087; AF Proj. 2306) (AD-A092371; RADC-TR-80-260) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report covers the modification of an Air Force owned IR-CCD Scanning System for one-dimensional scans. The modifications provide electronic instrumentation for: two-dimensional scanning, X-Y sweep circuitry for oscilloscope and TV compatible circuitry for video display and correlated double sampling circuitry for reduction of noise and analog signal conditioning. GRA

N81-16357# Ohio State Univ., Columbus. ElectroScience Lab.
AIRBORNE ANTENNA PATTERN CODE: USER'S MANUAL Interim Report
W. D. Burnside Griffiss AFB, N.Y. RADC Sep. 1980 108 p refs
(Contracts F30602-79-C-0068; N62269-78-C-0379; AF Proj. 4519)
(AD-A092316; ESL-711679-2; RADC-TR-80-302) Avail: NTIS HC A06/MF A01 CSCL 20/14

This report describes the use of a computer code to analyze antenna mounted on aircraft fuselage. Ram jet configurations can be handled as a special case by this code. The pattern can be taken in terms of an arbitrary conical cut. The organization of the code, definition of input and output data, multiple finite plate approach to simulate the structures on aircraft and various examples are presented. The analysis is based on the geometrical theory of diffraction, and various computed patterns are compared with experimental results. GRA

N81-16358# Rhode Island Univ., Kingston. Dept. of Mathematics.
OPTIMIZATION OF MULTICHANNEL PROCESSING Final Report
Oved Shisha Sep. 1980 12 p refs
(Grant AF-AFOSR-3174-77; AF Proj. 2304) (AD-A091987; AFOSR-80-1146TR) Avail: NTIS HC A02/MF A01 CSCL 09/3

The subset selection algorithm is extended to search for a best subset from a large set of complex-valued basis functions. This algorithm is used to design digital finite-duration impulse response (FIR) filters having fewer coefficients than conventional FIR filters. An optimum conventional FIR filter is derived which has best uniform spacing of the fixed number of samples which are to be used, and examples are presented which show that, for the same number of coefficients, the complex-subset-selection filter can give better results than the optimum conventional filter. The complex subset selection method is also applied to estimation of the frequencies of sinusoids in the presence of noise. A windowing technique is introduced to increase the efficiency and accuracy of the algorithm for frequency estimates. The results are compared with Cramer-Rao bounds. GRA

N81-16359# Georgetown Univ., Washington, D.C. Dept. of Electrical and Computer Science.
DISCRETE SCATTERING APPROACH TO VEGETATION MODELING Final Report
Roger H. Lang Apr. 1980 59 p refs
(Contract DAAK70-77-C-0142; DA Proj. 4A1-61102-B-52C) (AD-A092017; ETL-0215) Avail: NTIS HC A04/MF A01 CSCL 20/3

This report studies microwave backscattering from a forest canopy which is modeled by a collection of dielectric discs with random orientation and position. The report begins by analyzing the mean field in a tenuous distribution of discrete scatterers. The correlation of the field is found by employing the distorted Born approximation. The above is then specialized to a half space of discrete scatterers with azimuthal symmetry. Horizontal, vertical and cross polarized backscattering coefficients for the half space are found. A comparison with experiment is made for the special case of lossy dielectric discs. GRA

N81-16360# Communications Research Centre, Ottawa (Ontario). Radio and Radar Research Branch.
AN INVESTIGATION OF HF DIRECTION-FINDING ACCURACY ON THE FROBISHER BAY-OTTAWA AURORAL ZONE PATH
G. O. Venier Jul. 1980 40 p refs
(AD-A092312; CRC-TN-703) Avail: NTIS HC A03/MF A01 CSCL 17/3

The CRC HF direction-finding array, consisting of a 1181 meter by 236 meter cross, was used to make angle of arrival measurements of waves transmitted over a 2100 km path whose mid point was near the centre of the auroral zone. Swept-frequency transmissions allowed the investigation of the angle variations of individual propagation modes and fixed-frequency transmissions permitted the measurement of Doppler shifts as well as the sampling of the phase fronts at relatively high rates. E-mode propagation over this path appeared to be entirely of the sporadic variety, but still provided good azimuth accuracy with a median RMS error from the great circle direction around 0.4 degrees for the single-hop case. On the F mode, spreading in range occurred a significant percentage of the time in contrast to experience with lower-latitude paths. This spreading was accompanied by large departures in angle of arrival for this mode from the great circle direction. Two azimuth-estimation techniques were tested on the fixed-frequency data. One used a phase-front planarity test and averaging over relatively frequent samples while the other was based on the separation of modes by Doppler processing. The former technique was found to provide slightly better results than the latter on these data and its accuracy was, in most cases, close to that which could be obtained from the best mode when separated using swept frequency data. GRA

N81-16361# Communications Research Centre, Ottawa (Ontario). Radio and Radar Research Branch.
AN INVESTIGATION OF HF DIRECTION-FINDING ACCURACY ON THE CHURCHILL-OTTAWA AURORAL ZONE PATH
G. O. Venier Jul. 1980 26 p refs
(AD-A092311; CRC-TN-702) Avail: NTIS HC A03/MF A01 CSCL 17/3

The CRC HF Direction-Finding Array, consisting of a 1181 meter by 236 meter cross, was used to make angle-of-arrival measurements on HF waves propagated over a 1900 km path from Churchill, Manitoba to Ottawa, in May, 1976. This path is of interest because much of it is in the auroral zone where conditions are generally more disturbed than at lower latitudes. Swept-frequency transmissions allowed the investigation of the variations in angle of arrival of individual propagation modes, while fixed-frequency transmissions permitted a test of two azimuth-estimation schemes. One of these used a phase-front planarity test and averaging of azimuths over relatively frequent samples, while the other was based on the separation of modes by Doppler processing. The former technique was found to provide slightly better accuracy than the latter on this path and both compared well in accuracy with estimates from separated modes using swept-frequency data. GRA

N81-16362# Delta Information Systems, Inc., Jenkintown, Pa.
MEASUREMENT OF COMPRESSION FACTOR AND ERROR SENSITIVITY OF THE MODIFIED READ FACSIMILE CODING TECHNIQUE Final Report
Steven Urban and Richard Schaphorst Aug. 1980 99 p refs
(Contract DCA100-80-M-0145)
(AD-A092395; NCS-TIB-80-6) Avail: NTIS HC A05/MF A01 CSCL 17/2

This Technical Information Bulletin (TIB) describes the measurement of Compression factor and error sensitivity factor of the Modified READ two-dimensional facsimile coding technique. The TIB contains detailed flow charts and computer programming associated with this coding scheme. Compression factor and error sensitivity together with statistical data have also been tabulated. This TIB is a companion document to NCS TIB's 79-7, 79-8, 79-9, and 79-10. GRA

N81-16363# Megatek Corp., San Diego, Calif.
INTEGRATED REFRACTIVE EFFECTS PREDICTION SYSTEM (IREPS): PROGRAM PERFORMANCE SPECIFICATION, REVISION 2.0 Final Report
H. V. Hitney, E. W. Pasahow, and M. E. OBrian 7 Jul. 1980 413 p
(Contract N00123-78-C-0043; NR Proj. 532-059)
(AD-A092297; R2018-059-IF-2; NOSC/TD-365) Avail: NTIS HC A18/MF A01 CSCL 20/14

IREPS assesses the refractive effects of the lower atmosphere for Naval electromagnetic systems operating above 100 MHz including radar, uhf and microwave communications, electronic warfare and missile guidance. This specification defines and specifies the computer program functions required by IREPS. GRA

N81-16364# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.
CONCEPT EVALUATION: FIELD FEEDBACK COMPUTATION OF ELECTROMAGNETIC SCATTERING M.S. Thesis
Bryant E. Welch Jun. 1980 137 p refs
(AD-A092305) Avail: NTIS HC A07/MF A01 CSCL 20/14

A new method of numerical solution for time harmonic field scattering problems involving inhomogeneous bodies of revolution is presented. A simple single loop multiport feedback system is driven by the incident field. The forward path transfer matrix, found by use of the finite element method, translates the total near field into the body surface field. The feedback path matrix is established by the magnetic vector potential formulation; it translates the body surface currents into the scattered near field. The thin wire scattering problem is formulated in terms of this field feedback method. Results of this computation are compared in graphical form to those found by Hallen's integral equation solution of the scattering problem for several cases of interest. GRA

N81-16365# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LASER LIGHT FIBER COMMUNICATION
Huang Dingguo 14 Oct. 1980 17 p Trans. into ENGLISH from Wuxiandian (China), no. 5, 25 May 1979 p 1-3
(AD-A092096; FTD-ID(RS)T-1170-80) Avail: NTIS HC A02/MF A01 CSCL 17/2

A nontechnical overview of the development and capabilities of laser light fiber communication systems is presented. These systems are compared to conventional electronic communication and possible applications are discussed. M.G.

N81-16366# Tufts Univ., Medford, Mass. Dept. of Electrical Engineering.
ASPECTS OF SIGNAL PROCESSING FOR ARRAY ANTENNAS Final Scientific Report, 15 Jan. - 30 Sep. 1980
D. Preis 30 Sep. 1980 151 p refs Presented at the L'Aquila DSP Workshop, Italy, Sep., 1980
(Grant AF-AFOSR-0110-80; AF Proj. 2304)
(AD-A092734; EE/TR-1980-1; AFOSR-80-1242TR) Avail: NTIS HC A08/MF A01 CSCL 09/5

Deconvolution algorithms are given for the computer-aided design of transversal-filter equalizers. These filters can be used to filter signals from individual elements of a sensing array or for array equalization. Minimax design procedures are developed for both continuous time and discrete-time cases. Also, least-square error and envelope constrained designs are considered. Essential design equations, numerous computed examples, mathematical details, and several computer codes are included. GRA

N81-16367# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical Engineering.
RECOVERY FROM NODE FAILURE IN A CONTRACT NET M.S. Thesis - MIT
Philip Steven Prince, Jr. Aug. 1980 67 p refs
(AD-A092517; AFIT-CI-80-47T) Avail: NTIS HC A04/MF A01 CSCL 17/2

The problem of a catastrophic node failure in a contract net is addressed. The Stanford Research Institute Problem Solver (STRIPS) will be distributed by means of the contract net protocol, and used as a medium for studying the methods that might be used to recover from the node failure. Four methods will be described and compared, with respect to normal and recovery operational costs. GRA

N81-16368# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Electrical Engineering.
ERROR PERFORMANCE OF DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS ON NONSELECTIVE GENERALIZED RAYLEIGH FADING CHANNEL Ph.D. Thesis - Illinois Univ. at Urbana-Champaign
Robert Charles Hanlon Apr. 1980 113 p refs
(AD-A092516; AFIT-CI-80-13T) Avail: NTIS HC A06/MF A01 CSCL 17/2

The error performance of direct sequence spread spectrum multiple access communications systems on nonselective fading channels is investigated. The channels considered are those for which the fading intensity is slow, nonselective, and exhibits a generalized Rayleigh distribution. The generalized Rayleigh distribution encompasses the important special cases of a Rician (specular plus Rayleigh) fading, Nakagami m-distributed fading, and Rayleigh fading. Results are obtained for the special cases of a single cochannel interferer without additive noise and multiple independent cochannel interferers with additive white Gaussian noise. The results are developed as a series expansion in the moments of the cross-correlation between the spreading codes (single interferer) or a series expansion in the powers of the second moment of the code cross-correlation (multiple interferers). To develop simple estimates of the probability of error, empirical estimates of the low-order cross-correlation moments of the spreading codes (taken to be Gold codes) are developed from a generalized gamma density approximation based on the cross-correlation moments for both Gold codes and random codes. Numerical results for the probability of error are obtained with these estimates and compared with the results based on exact moments developed from the code cross-correlation probability density. GRA

N81-16369# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
EFFECTS OF CROSS-CORRELATION INTERFERENCE ON AN OPTICAL CODE DIVISION MULTIPLE ACCESS COMMUNICATION SYSTEM Ph.D. Thesis - Illinois Univ.
George Dennis Peterson 1980 126 p refs
(AD-A092523; AFIT-CI-80-23D) Avail: NTIS

HC A07/MF A01 CSCL 17/2

The effects of cross-correlation interference and intensity fading on the error rate performance of an optical code division multiple-access communication system are investigated. The system model is a multiaccess satellite repeater in which user separation is accomplished by direct sequence modulation. The analysis is for direct detection, optical polarization modulation systems. Generalized expressions for the conditional probability of error for the uplink and downlink channels are derived in terms of the number of active users, signal strength and the normalized cross-correlation between user codes. Numerical results are obtained for systems of two users, for both length 31 and 127 Gold codes. Analysis of a random sampling of the length 31 codes has shown that performance is significantly dependent on the magnitude of the normalized second moment of the cross-correlation between user codes. Further analysis showed that the error probability decreases with increasing code length. The multiuser capabilities of the uplink and downlink channels were shown to differ significantly. GRA

N81-16370# Army Communications Research and Development Command, Fort Monmouth, N. J. Center for Communications Systems.

THROW-AWAY RADIO (TAR) Final Report

Joseph Lee Nov. 1980 33 p

(DA Proj. 1L1-61101-A91A)

(AD-A092717; CORADCOM-80-2) Avail: NTIS HC A03/MF A01 CSCL 17/2

Military grade components, extensive testing and modular construction are generally required for military communication equipment to provide high reliability and maintainability. The full military environment is rarely encountered in non-critical mission communications and thus a low cost, throw-away radio could be used in these missions. This report covers the investigation of a low cost, handheld transceiver concept. Representative schematics and discussions are presented and the cost for components is estimated. Although a working model was not completed, the investigation demonstrated that a low cost radio can be developed and fabricated at approximately one-fourth the cost of a similar, fully militarized unit. GRA

N81-16371# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

SPEECH COMPRESSION AND SYNTHESIS Final Report, 8 Jun. 1979 - 31 Jul. 1980

Michael Berouti, John Makoul, Richard Schwartz, and John Sorenson Oct. 1980 119 p refs

(Contract F19628-78-C-0136; ARPA Order 3515)

(AD-A092578; BBN-4414) Avail: NTIS HC A06/MF A01 CSCL 17/2

This report concludes our work for the past two years on speech compression and synthesis. A real-time variable-frame-rate LPC vocoder was implemented operating at an average rate of 2000 bits/s. We also tested our mixed-source model as part of the vocoder. To improve the reliability of the extraction of LPC parameters, we implemented and tested a range of adaptive lattice and autocorrelation algoritms. For data rates above 5000 bits/s, we developed and tested a new high-frequency regeneration technique, spectral duplication, which reduces the roughness in the synthesized speech. As the first part of our effort towards a very-low-rate (VLR) vocoder, we implemented a phonetic synthesis program that would be compatible with our initial design for a phonetic recognition program. We also recorded and partially labeled a large data base of diphone templates. During the second year we continued our work toward a VLR vocoder and also developed a multirate embedded-coding speech compression program that could transmit speech at rates varying from 9600 to 2400 b/s. The phonetic synthesis program and the labeling of the diphone template network were completed. There are currently 2845 diphone templates. We also implemented an initial version of a phonetic recognizer based on a network representation of diphone templates. The recognizer allows for incremental training of the network by modification of existing templates or addition of new templates. GRA

N81-16372# RAND Corp., Santa Monica, Calif.

TRANSMISSION AND ORBITAL CONSTRAINTS IN SPACE RELATED PROGRAMS: PROJECT DESCRIPTION Interim Report

A. L. Hiebert and A. F. Brewer Aug. 1980 49 p refs

(Contract F49620-77-C-0023)

(AD-A092522; RAND/N-1536-AF) Avail: NTIS HC A03/MF A01 CSCL 22/2

Future growth in commercial and military space systems is constrained by technical problems associated with the frequency spectrum, by orbital congestion, and by costs stemming from proliferated terminals. The authors outline an Air Force sponsored research project to design and develop a capability for predicting and analyzing the spectrum/orbital geometry requirements of current and projected U.S. and international space-related systems. The two essential components of the project are a comprehensive space environment data base and a computer analysis program. In combination, they will provide a resource for evaluating engineering and architecural designs, identifying and analyzing the impact of intentional and unintentional electromagnetic interference, and predicting probable saturation conditions in spectrum usage and satellite/orbital positions. The project will include assessments of ways to accommodate anticipated growth. It will be structured for a continuing analysis program, which will be accessible to the space community as operational capabilities are acquired. GRA

N81-16373# Sierra Geophysics, Inc., Arcadia, Calif.

RELATIVE RECEIVER FUNCTIONS FOR THREE DIFFERENT ARRAY CONCEPTS Semiannual Technical Report, 1 Dec. 1977 - 31 May 1980

G. M. Lundquist, G. R. Mellman, and D. M. Hadley 1 Jul. 1980 51 p refs

(Contract F08606-79-C-0009; ARPA Order 2551)

(AD-A092727; SGI-R-80-021) Avail: NTIS HC A04/MF A01 CSCL 08/11

This technical report summarizes work done during the period December 1979 - May 1980 on the computation of relative receiver functions. Such functions are vitally important to the understanding of explosion or earthquake source functions, since the effects of crustal reverberations, local amplification effects and lateral variations in attenuation near seismic stations cannot otherwise be separated from source or source crustal properties. Two steps are involved in the calculation. Trace deconvolutions generated by spectral ratios are averaged in the log-spectral domain. Then the relative receiver functions are computed for all stations in an array by use of a non-linear recursive technique. The result is a filter which may be used to model near receiver contributions to synthetic seismograms of stations in the array. Results are presented for three different array concepts, including a small array of a few kilometers aperture, an array made up of all of the WWSSN stations in the western U.S. and an array made up of all SRO stations in a usable distance range about the Eastern Kasakh test site. In each case, the methods are applied successfully with the primary limitations being data availability. GRA

N81-16374# Princeton Univ., N. J. Dept. of Electrical Engineering and Computer Science.

NOVEL DIGITAL SIGNAL PROCESSING AND DETECTION TECHNIQUES Interim Scientific Report, 1 Aug. 1979 - 31 Jul. 1980

Bede Liu Sep. 1980 8 p refs

(Grant AF-AFOSR-3083-76; AF Proj. 2304)

(AD-A092815; AFOSR-80-1181TR) Avail: NTIS HC A02/MF A01 CSCL 09/3

A number of results were obtained during the period 1 August 1979 to 30 July 1980. Studies were made of the implementation of narrowband digital filters with reduced roundoff error and limit cycle oscillations. Bounds on limit cycles of second order filters were derived for filters using error spectrum shaping. The performance of two sequential signal detectors was analyzed. A scheme for the computer generation of random sequences with a specified first order distribution and a specified autocovariance function is proposed and analyzed. A delta modulation like sampled analog filter structure is developed. The filter uses only coefficients 0,-1, and -1 and can be fabricated as a programmable CCD filter. Work has begun on a further refinement of narrowhead spectrum analysis by direct decimation and on the use of recursive filters for decimation and interpolation. GRA

N81-16375# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

FUNCTIONAL TESTING COMMUNICATION EQUIPMENT (AVIONICS) Final Report

31 Jul. 1980 35 p refs Supersedes MTP-6-3-025 and MTP-6-3-024

(AD-A092825; TOP-6-3-025; MTP-6-3-025; MTP-6-3-024) Avail: NTIS HC A03/MF A01 CSCL 17/2

This document provides guidance and procedures for performance testing airborne communication equipment. The document addresses the following: Communication Range, Transmission Pattern, Homing, Retransmission, Effects of Atmospheric Conditions and Durability. It provides the test project officer with general information and guidance in test preparation, test controls, test conduct and data reduction. GRA

N81-16376# Sandia Labs., Albuquerque, N. Mex. Numerical Mathematics Div.

NUMERICAL EVALUATION OF THE TRANSFER IMPEDANCE OF TWO PARALLEL LOOP ANTENNAS

D. E. Amos Sep. 1980 22 p refs Sponsored by DOE

(SAND-80-1847) Avail: NTIS HC A02/MF A01

A Fourier integral representation of the complex transfer impedance of two parallel loop antennas of radius a, separated on a common axis by a distance d, is converted into an integral I sub 1 whose integrand decays exponentially. This integral is further manipulated to produce a series representation which can be used numerically when d is = to or > 3a. A second integral I sub 2, whose integrand also decays exponentially, is derived and, like I sub 1, converges for d > 0. While a quadrature on I sub 1 can be performed when d < 3A, the quadrature requires evaluations of the J sub 1 Bessel function of a complex argument. However, the integrand of I sub 2 requires only elementary functions of complex arguments and the J sub 1 Bessel function of real arguments. Consequently, a quadrature on I sub 2 for d < 3a is recommended to complement the series evaluation for d is = to or > 3a. Author

N81-16377# California Univ., Livermore. Lawrence Livermore Lab.

PARAMETER ESTIMATION FROM NOISY TRANSIENT ELECTROMAGNETIC MEASUREMENTS

D. T. Gavel, J. V. Candy, and D. L. Lager 1980 35 p refs Presented at Nucl. EMP Meeting, Anaheim, Calif., 5-7 Aug. 1980 Submitted for publication

(Contract W-7405-eng-48)

(UCRL-84437; CONF-800842-1) Avail: NTIS HC A03/MF A01

The performance of three different signal processing techniques which was applied to parameterize a body from noisy experimental electromagnetic transient response data is reported. The techniques, which range from the well known Prony method to the more sophisticated extended Kalman filter and finally to the highly sophisticated maximum likelihood identifier, are described. The performance of these algorithms was compared and their tradeoffs are discussed. T.M.

N81-16378# Federal Communications Commission, Washington, D. C. Private Radio Bureau.

LAND MOBILE SPECTRUM UTILIZATION: SAN FRANCISCO, CALIFORNIA AND CHICAGO, ILLINOIS Final Report

Larry D. Reed Aug. 1980 134 p refs

(PB80-218746; FCC/PRB/RDL-80-01) Avail: NTIS HC A07/MF A01 CSCL 17B

Radio frequency utilization by Federal Communication Commission licenses in the San Franciso and Chicago urbanized areas is described. The license include among others: police and fire departments; hospitals; public utilities; marine; and common carrier users. The extent of frequency utilization is described in terms of four occupancy categorizations (zero, low, substantial and very high). The rationale for these categories and their relationship to measured usage data is given. Summary tables enable direct comparison of the use by various individual, radio services, e.g., police, business, taxicab, etc. Separate analyses are given for utilization by each of the land mobile radio services and for each frequency band. GRA

N81-16379# Massachusetts Inst. of Tech., Cambridge. Marine Industry Advisory Services.

A NEW UNDERWATER COMMUNICATION SYSTEM

Norman Doelling 7 Jul. 1980 23 p refs Sponsored by NOAA

(PB81-108128; MITSG-80-6; Opportunity-Brief-19; NOAA-80091502) Avail: NTIS HC A02/MF A01 CSCL 17B

A functional prototype of a sonar modem was tested. The leading edge technologies were used to implement the system to allow programmable modifications of the system to suit a range of data communication needs. Questions concerning user needs and applications were addressed. R.C.T.

N81-16380# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

REQUIREMENTS, DESIGN AND DEVELOPMENT OF LARGE SPACE ANTENNA STRUCTURES

May 1980 48 p refs Presented at the 49th Struct. and Mater. Panel Meeting, Porz-Wahn, West Germany, 7-12 Oct. 1979

(AGARD-R-676; ISBN-92-835-1358-4) Avail: NTIS HC A03/MF A01

The structural and materials requirements for space antennas are reviewed. The constraints imposed by the particular application and the space environment are addressed. In addition, structural design problems of large space structures and space telescopes are considered. For individual titles, see N81-16381 through N81-16383.

N81-16381# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.

STRUCTURAL REQUIREMENTS AND CONSTRAINTS OF HIGH GAIN SATELLITE ANTENNAS FOR 30/20 GHz COMMUNICATIONS

Shabeer Ahmed *In* AGARD Requirements, Design and Develop. of Large Space Antenna Struct. May 1980 5 p refs (For primary document see N81-16380 07-32)

Avail: NTIS HC A03/MF A01

The types of satellite antennas, the mission constraints and environments for which they must be designed and the demands placed on the materials and structures of a reflector antenna to satisfy mission requirements are briefly outlined. The advantages and disadvantages of lens and phased array antennas are covered. The dimensional accuracy requirement of reflector antennas for 30/20 GHz communications is extremely stringent. The factors that contribute to dimensional inaccuracies are the structural design process, the physical properties of the constituent materials and the fabrication process that is utilized. Other antenna structural requirements include: low mass, to obtain the most payload in orbit; high strength, to withstand both launch loads and ground handling; and high stiffness, to withstand launch loads and to minimize interactions with the satellite control system. The antenna design must be capable of being verified in the 1 g environment on the ground. It must be capable of maintaining its designed geometric configuration in the space thermal environment. To meet this last requirement, an important design factor is the choice of materials which have low coefficients of thermal expansion and high thermal conductivity. Additional thermal protection is obtained from multilayer insulation blankets made of metallized plastic. Suggestions for structures and materials development are given. M.G.

N81-16382*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NASA TECHNOLOGY FOR LARGE SPACE ANTENNAS

Richard A. Russell, Thomas G. Campbell, and Robert E. Freeland (JPL) *In* AGARD Requirements, Design and Develop. of Large Space Antenna Struct. May 1980 2 p refs (For primary document see N81-16380 07-32)

Avail: NTIS HC A03/MF A01 CSCL 09C

Some leading concepts for deployable antennas are described and an assessment of the state of the art in deployable antennas is presented. The advanced sunflower precision antenna, the radial rib antenna and the maypole (hoop/column) antenna, the wrap rib antenna and the parabolic erectable truss antenna are covered. In addition, a discussion on the technology development program for two deployable antenna concepts that are responsive to the

antenna mission requirements as defined in the NASA mission model is presented. M.G.

N81-16383# British Aerospace Dynamics Group, Stevenage (England).
TYPICAL EXAMPLES OF EUROPEAN TECHNOLOGY FOR HIGH STABILITY SPACE STRUCTURES
J. F. Clemmet *In* AGARD Requirements, Design and Develop. of Large Space Antenna Struct. May 1980 10 p (For primary document see N81-16380 07-32)
Avail: NTIS HC A03/MF A01

Two contrasting, primary areas of application of highly underformable space structures are identified to illustrate the state of the art in the European space industry. The technologies associated with the structures of high gain antennas and space telescopes are illustrated by selected examples. The philosophies adopted in translating the electrical or optical requirements initially into mechanical and thermal designs, and subsequently into hardware, are presented. Attention is given to deformations induced by launch and on station environments, to methods of controlling local environments and to demands from terrestrial assembly and integration. In addition to existing designs and hardware, current trends and developments are identified. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N81-16384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GYROTRON TRANSMITTING TUBE Patent Application
Henry G. Kosmahl, inventor (to NASA) Filed 24 Dec. 1980 9 p
(NASA-Case-LEW-13429-1; US-Patent-Appl-SN-220212) Avail: NTIS HC A02/MF A01 CSCL 09A

An R.F. transmitting tube for the 20 GHz to 500 GHz range comprises a gyrotron and a multistage depressed 5 collector. A winding provides a magnetic field which acts on spent, spinning or orbiting electrons changing their motion to substantially forward linear motion in a downstream direction. The spent electrons then pass through a focusser into the collector. Nearly all of the electrons injected into the collector will remain within an imaginary envelope as they travel forward toward the end collector plate. The apertures in the collector plates are at least as large in diameter as the 5 envelope at any particular axial position. NASA

N81-16385*# National Aeronautics and Space Administration. Pasadena Office, Calif.
AN IMPROVED SOLID ELECTROLYTE CELL Patent Application
Robert Richter, inventor (to NASA) (JPL) Filed 24 Dec. 1980 14 p
(Contract NAS7-100)
(NASA-Case-NPO-15269-1; US-Patent-Appl-SN-220214) Avail: NTIS HC A02/MF A01 CSCL 09A

A solid electrolyte cell is disclosed which includes a body of solid gas-conductive electrolytes having mutually spaced surfaces on which a number of mutually spaced electrodes are deposited. Strips of bare substrate are interposed between the electrodes so that currents of ionic gas may be established between the electrodes. Electrical resistance for the cells is lowered and the gas conductivity is enhanced. NASA

N81-16386*# National Aeronautics and Space Administration. Pasadena Office, Calif.
TACTILE SENSING SYSTEM Patent Application
Marc Raibert (JPL, California Inst. of Technology, Pasadena) and Raymond Eskenazi, inventors (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 16 Jan. 1981 9 p
(Contract NAS7-100)
(NASA-Case-NPO-15094-1; US-Patent-Appl-SN-225500) Avail: NTIS HC A02/MF A01 CSCL 09C

A tactile sensing system comprises a sheet of flexible material on top of a semiconductor layer on which an array of electrodes is formed. Computing elements are present in the layer and are connected via lines to the electrodes, to each other and to an external sequence controller and a manipulator collector. The electrodes, the computing elements and the interconnecting lines are formed by large scale integration, thereby resulting in a relatively small sensor with a dense array of electrodes convertible to the external circuitry by a minimum number of wires. NASA

N81-16387*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Space Power Applications Branch.
THE CHARACTERISTICS AND LIMITATIONS OF THE MPS/MMS BATTERY CHARGING SYSTEM
Floyd E. Ford, Charles F. Palandati, John F. Davis, and C. Michael Tasevoli Nov. 1980 92 p refs
(NASA-TM-81983) Avail: NTIS HC A05/MF A01 CSCL 09C

A series of tests was conducted on two 12 ampere hour nickel cadmium batteries under a simulated cycle regime using the multiple voltage versus temperature levels designed into the modular power system (MPS). These tests included: battery recharge as a function of voltage control level; temperature imbalance between two parallel batteries; a shorted or partially shorted cell in one of the two parallel batteries; impedance imbalance of one of the parallel battery circuits; and disabling and enabling one of the batteries from the bus at various charge and discharge states. The results demonstrate that the eight commandable voltage versus temperature levels designed into the MPS provide a very flexible system that not only can accommodate a wide range of normal power system operation, but also provides a high degree of flexibility in responding to abnormal operating conditions. E.D.K.

N81-16388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE ELECTRONIC REQUIREMENTS IN AEROPROPULSION SYSTEMS
William C. Nieberding and J. Anthony Powell 1981 5 p refs Proposed for presentation at High-Temp. Electron. Conf., Tucson, Ariz., 25-27 Mar. 1981; sponsored by NASA, DOE and IEEE
(NASA-TM-81682; E-708) Avail: NTIS HC A02/MF A01 CSCL 09C

This paper discusses the needs for high temperature electronic and electrooptic devices as they would be used on aircraft engines in either research and development applications, or operational applications. The conclusion reached is that the temperature at which the devices must be able to function is in the neighborhood of 500 to 600 C either for research and development or for operational applications. In research and development applications, the devices must function in this temperature range when in the engine but only for a moderate period of time. On an operational engine, the reliability requirements dictate that the devices be able to be burned-in at temperatures significantly higher than those at which they will function on the engine. The major point made is that semiconductor technology must be pushed well beyond the level at which silicon will be able to function. Author

N81-16389*# TRW Systems Group, Redondo Beach, Calif.
K-BAND HIGH POWER LATCHING SWITCH Final Report
M. J. Mlinar, W. S. Piotrowski, and J. E. Raue 19 Dec. 1980 49 p refs
(Contract NAS3-21761)
(NASA-CR-165159; Rept-34037) Avail: NTIS HC A03/MF A01 CSCL 09A

A 19 GHz waveguide latching switch with a bandwidth of 1400 MHz and an exceptionally low insertion loss of 0.25 dB was demonstrated. The RF and driver ferrites are separate structures and can be optimized individually. This analysis for each structure is separately detailed. Basically, the RF section features a dual turnstile junction. The circulator consists of a dielectric tube which contains two ferrite rods, and a dielectric spacer separating the ferrite parts along the center of symmetry

of the waveguide to form two turnstiles. This subassembly is indexed and locked in the center of symmetry of a uniform junction of three waveguides by the metallic transformers installed in the top and bottom walls of the housing. The switching junction and its actuating circuitry met all RF performance objectives and all shock and vibration requirements with no physical damage or performance degradation. It exceeds thermal requirements by operating over a 100 C temperature range (-44 C to +56 C) and has a high power handling capability allowing up to 100 W of CW input power. A.R.H.

N81-16390# Philips Labs., Briarcliff Manor, New York. Component and Device Research Group.
OPTIMIZED PYROELECTRIC VIDICON THERMAL IMAGER. VOLUME 1: THERMAL IMAGER. VOLUME 1A: RAIN CAMERA. VOLUME 1B: RETICULATION Final Report, 7 Jun. 1978 - 14 Apr. 1979
Richard Kurczewski, E. Stupp, Peter Murau, and Barry Singer Jun. 1979 36 p
(Contract DAAG53-76-C-0053)
(AD-A092565) Avail: NTIS HC A03/MF A01 CSCL 17/5

A technique for suppressing the noise resulting from pedestal generation in the pyroelectric vidicon has been developed. System modifications were implemented to provide reduced bandwidth and line rates in order to effect a factor of four bandwidth reduction. Under these conditions, the pedestal noise is completely dominant. Implementation of the pedestal noise suppression technique then results in a factor between three and four improvement in the MRT's. Performance of the chopped-mode system is close to the best performance reported for the pan mode. Reticulation of the TGS family of pyroelectric targets was demonstrated using standard ion-milling techniques. Reticulation of DTGFB was successfully demonstrated by reactive ion milling using aluminum as a mask. The optimum depth achieved in the latter case was 18-20 micrometers, which translates into an aspect ratio of about 4:1. Both reticulated DTGS and DTGFB targets were successfully constructed wherein individual dice were completely isolated from neighboring dice such that thermal spread was minimized. Several PEVs with reticulated targets were evaluated which indicate significant improvement in performance of DTGS targets and some modes improvement of DTGFB targets over single crystal targets. The optimum effect of reticulation at high spatial frequencies has been realized with DTGS targets but not yet with DTGFB targets. GRA

N81-16391# Philips Labs., Briarcliff Manor, New York. Exploratory Research Group.
OPTIMIZED PYROELECTRIC VIDICON THERMAL IMAGER. VOLUME 2: IMPROPER FERROELECTRIC CRYSTAL GROWTH Final Technical Report, Aug. 1978 - Nov. 1979
Wallace Arden Smith, Gabriel Loiacono, and Avner Shaulov Sep. 1980 143 p refs
(Contract DAAG53-76-C-0053)
(AD-A092566) Avail: NTIS HC A07/MF A01 CSCL 17/5

Complete dielectric, pyroelectric, and thermal characterizations of Fe3B7O13I, Cu3B7O13C1 and Mn3B7O13I were performed to confirm the expectation that the boracite family of improper ferroelectrics exhibits high pyroelectric open-circuit voltage response. In each of these materials, the figure of merit, p/epsilon c, rises as the transition temperature is approached; the peak value attained at the transition varies only slightly in a temperature interval of several degrees below the transition. The peak figures-of-merit of these materials are larger than that of TGS and close to that of DTGFB (FeI: 6,000 sq. cm/c; CuCI: 6,000 sq. cm/c; MnI: 5,300 sq cm/c). A vapor-transport growth technique was developed which can produce boracite single crystals of sufficient size for device applications. Complete dielectric, pyroelectric, and thermal characterizations of the dicalcium lead propionate (DLP) Ca2Pb(C2H5COO)6 and dicalcium strontium propionate (DSP) family of pseudo-proper ferroelectrics exhibits a high, broad maximum in their figures of merit. The measured figures-of-merit are larger than that of TGS and close to that of DTGFB (DLP: 5,000 sq. cm/c; DSP: 5,700 sq cm/c). A solution growth technique was developed which has produced single crystals of size and quality already adequate for device application. GRA

N81-16392# Naval Ocean Systems Center, San Diego, Calif.
ELECTRONIC DESIGN OF AN ELECTRONIC HIGH TORQUE-TO-INERTIAL SERVOSYSTEM. CANDIDATE SYSTEM USES INCLUDE MISSILE GUIDANCE, SURVEILLANCE, AND TRACKING Final Report, Jul. 1979 - Jan. 1980
C. F. Buman Apr. 1980 81 p refs
(AD-A092141; NOSC/TD-356) Avail: NTIS HC A05/MF A01 CSCL 09/5

Electronic design and development of a high torque-to-inertia servosystem for stabilizing a sensor system are described. The design philosophy leads to a low-cost/high-performance system. The stabilizing element developed is universal and has application for (1) missile guidance, (2) surveillance, and (3) tracking sensor systems. The servo design is based on math models and is used for electronic design implementation and evaluation. GRA

N81-16393# RCA Corp., Lancaster, Pa. SSD-Electro Optics and Devices.
MANUFACTURING METHODS AND TECHNOLOGY MEASURE FOR FABRICATION OF SILICON TRANSCALENT RECTIFIER Final Technical Report, 30 Jun. 1978 - 31 Mar. 1980
B. B. Adams, M. F. DeVito, and R. E. Reed Sep. 1980 142 p
(Contract DAAK70-78-C-0120)
(AD-A092078) Avail: NTIS HC A07/MF A01 CSCL 09/1

RCA has successfully completed the fabrication and testing of fifteen sample devices under this contract. This report thoroughly describes and discusses the assembly and process procedures; test circuits and test results; and configuration management procedure. It also includes numerous detailed drawings and graphs to futher illustrate the ingenuity of this silicon transcalent rectifier. GRA

N81-16394# RCA Corp., Lancaster, Pa. SSC-Electro-Optics and Devices.
MANUFACTURING METHODS AND TECHNOLOGY (MMT) MEASURE FOR FABRICATION OF SILICON TRANSCALENT TRANSISTOR Final Technical Report, 2 Apr. 1979 - 30 Mar. 1980
M. F. DeVito, S. W. Kessler, R. E. Reed, and D. R. Trout Sep. 1980 141 p refs
(Contract DAAK70-79-C-0019)
(AD-A092079) Avail: NTIS HC A07/MF A01 CSCL 09/1

The design of a silicon transcalent transistor, its fabrication and its evaluation are detailed. The transcalent transistor, type J15381, is a triple diffused, bipolar NPN silicon transistor assembly mounted in a ruggedized, heat pipe cooled military package with integral fins for forced air cooling. Both high voltage and high current capabilities are achieved in small size, light weight assembly that has a large safe operating area. The test equipment used for the electrical, mechanical and environmental evaluations is described. M.G.

N81-16395# Naval Postgraduate School, Monterey, Calif.
THERMAL ANALYSIS AND DESIGN OF AIR COOLED ELECTRONIC CIRCUIT BOARDS USING A DESKTOP COMPUTER
Ricky Allen Foltz Jun. 1980 136 p refs
(AD-A092309) Avail: NTIS HC A07/MF A01 CSCL 09/3

A thermal design procedure for air cooled electronic circuit boards has been developed for the Hewlett-Packard Model 9845 desktop computer. The system of interactive programs, called THERMELEX, performs thermal analysis of printed circuit boards to predict either junction temperatures for given power dissipation levels or the maximum power levels for given junction temperature limits. The system includes the following features: totally interactive with all input in question and answer format; simple data verification and correction capabilities; ability to store and retrieve circuit board descriptive data totally under program control; and wide variety of output formats including tabular and graphical. By using internal selection of heat transfer correlations, the THERMELEX system depends only on input of physical parameters for thermal predictions. GRA

N81-16396# Raytheon Co., Waltham, Mass.
POWER FET CONTACT TECHNOLOGY Final Technical Report, 1 Sep. 1978 - 31 Jul. 1980
R. Mozzi and Y. Tajima Sep. 1980 80 p refs

(Contract N00014-78-C-0622; RF6258001)
(AD-A092320; S-2796) Avail: NTIS HC A05/MF A01 CSCL 09/1

Unalloyed TiPtAu ohmic contacts were formed on n-type GaAs by preparing surfaces having over 10 to the 19th power carriers/cc prior to metal deposition. Two methods were used, vapor phase epilayer growth and pulse electron beam annealed (PEBA) selenium implants. The former method yielded specific contact resistivities .000008 + or - r(c) + or - .00009 ohm sq. cm and was successfully applied on power FET devices. Much lower resistivities, r(c) approx. 3 to the -7th power ohm sq. cm, were obtained by PEBA implants but difficulties associated with preserving channel layers through the PEBA exposure have precluded their application in a device configuration. GRA

N81-16397# RCA Solid State Div., Somerville, N.J.
FEASIBILITY STUDY OF THE COMBINATION OF MNOS ELEMENTS AND BIPOLAR TTL PERIPHERALS ON AN LSI CIRCUIT CHIP Final Technical Report, 29 Sep. 1978 - 29 Jun. 1979
Kevin Cunniff Griffiss AFB, N.Y. RADC Aug. 1980 208 p refs
(Contract F19628-78-C-0178)
(AD-A091952; RADC-TR-80-177) Avail: NTIS HC A10/MF A01 CSCL 09/5

The objective of this research was to obtain radiation, reliability and performance data on monolithic test structures containing MNOS memory transistors and n-p-n bipolar transistors. The data indicates that the devices performed acceptably at 100,000 rads (Si). Thin-oxide structures performed satisfactorily after exposure to 500,000 rads(Si). Thus, if these devices were combined into an EAROM memory circuit, a hardness level above 100,000 rads should result. Performance, reliability and breakdown characteristics were measured and are consistent with parameter values that would be useful for an EAROM. GRA

N81-16398# Oklahoma State Univ., Stillwater. Electronics Lab.
TEN-BIT RESOLUTION PCM ENCODER (FALLING SPHERE EXPERIMENT) Scientific Report, Apr. 1979 - Jan. 1980
Richard F. Buck Hanscom AFB, Mass. AFGL 1 Feb. 1980 50 p
(Contract F19628-78-C-0033; AF Proj. 7659)
(AD-A092111; AFGL-TR-80-0071; SR-2) Avail: NTIS HC A03/MF A01 CSCL 09/5

A miniature PCM encoder with 10 bit resolution was developed for use on the falling sphere experiment. Use of CMOS logic elements and an internal power supply resulted in a compact light-weight unit with minimal power demand suitable for use in the 10 inch diameter instrument, for measurement of atmospheric density. A bi-phase level coded system is used, with data input capability of fifteen bipolar (plus or minus 5 vdc) analog data lines, each sampled 125 times per second. Subcommunication of up to seven housekeeping monitors (each 0 to -5 vdc, analog level) is also included. Details of circuit design and test evaluation of the prototype unit are covered; the report is written to serve as a technical manual for the equipment, and also covers an associated test set. GRA

N81-16399# Stanford Univ., Calif. Integrated Circuits Lab.
COMPUTER-AIDED ENGINEERING OF SEMICONDUCTOR INTEGRATED CIRCUITS Final Report, 1 Jan. 1979 - 15 Feb. 1980
J. D. Meindl, R. W. Dutton, J. F. Gibbons, C. R. Helms, J. D. Plummer, W. A. Tiller, C. P. Ho, K. C. Saraswat, B. E. Deal, T. I. Kamins et al Jul. 1980 402 p refs
(Contract MDA903-79-C-0257; ARPA Order 3709)
(AD-A091969; SU-TR-DXG501-80; SU-ICL-17-78; DELET-TR-79-0257-1) Avail: NTIS HC A18/MF A01 CSCL 09/5

Economical procurement of small quantities of high performance custom integrated circuits for military systems is impeded by inadequate process, device and circuit models that handicap low cost computer aided design. The principal objective of this program is to formulate physical models of fabrication processes, devices and circuits to allow total computer-aided design of custom large-scale integrated circuits. The basic areas under investigation are (1) thermal oxidation, (2) ion implantation and diffusion, (3) chemical vapor deposition of silicon and refractory metal silicides, (4) device simulation and analytic measurements. This report discusses the fourth year of the program. GRA

N81-16400# California Univ., Berkeley. Electronics Research Lab.
RESEARCH IN MONOLITHIC, SIGNAL-PROCESSING CIRCUITS Final Report, 1 May 1977 - 31 Aug. 1980
R. G. Meyer and D. O. Pederson Oct. 1980 8 p refs
(Grant DAAG29-77-G-0132)
(AD-A091902; ARO-14698.6-EL) Avail: NTIS HC A02/MF A01 CSCL 09/5

This report summarizes research results in monolithic signal processing circuits. New approaches to monolithic crystal oscillator design are described together with new circuits for temperature-stable monolithic voltage-controlled oscillators. A major new theory of noise in switching oscillators has been developed and applied. In device research, a new ion-implanted buried reference diode has been devised. A publication list describing this work is included together with a list of associated Ph.D. and M.S. reports. GRA

N81-16401# California Univ., Davis. Signal and Image Processing Lab.
DESIGN AND IMPLEMENTATION OF MULTI-INPUT ADAPTIVE SIGNAL EXTRACTIONS Final Report, 1 Jun. 1979 - 31 May 1980
William A. Gardner and Michael A. Soderstrand 31 Jul. 1980 54 p refs
(Contract F49620-79-C-0086; AF Proj. 2304)
(AD-A092265; SIPL-80-11; AFOSR-80-1054TR) Avail: NTIS HC A04/MF A01 CSCL 09/3

This covers research on design and implementation of novel adaptive digital signal processors for signal extraction (i.e., reduction of noise, interference and sitrotion). The signal extractor configurations and adaptive adjustment schemes considered are extensions and generalizations of prior art (viz., the FIR digital filter and the LMS adjustment algorithm) that consist of various combinations and interconnections of conventional adaptive filtering and noise cancelling configurations and associated adaptive adjustment schemes. The methods of implementation considered are based on speed-cost efficient Residue Number System arithmetic and include Read Only Memory table look-up and microprocessors and minicomputers for hardware control and for software implementation. The major goal of the research is improvements over prior art in signal extraction performance (as measured by signal distortion, signal-to-noise ratio and mean squared error) and in the cost of implementation and speed of operation. Results on both design and implementation of configurations and adjustment schemes are described. GRA

N81-16402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF RELIABILITY OF SEMICONDUCTOR INTEGRATED CIRCUITS IN PLASTIC HOUSINGS
Jakub Grycan 24 Oct. 1980 24 p refs Transl. into ENGLISH from Elektronika (Poland), no. 9, 1973 p 390-396
(AD-A092095; FTD-ID(RS)T-1143-80) Avail: NTIS HC A02/MF A01 CSCL 09/1

The influence of circuit housing materials on the performance of semiconductor integrated circuits is investigated. It is noted that among semiconductor integrated circuits in housings which have been made of classic resins, i.e., epoxy A, phenolic and silicone, semiconductor integrated circuits in silicone housings display the best characteristics with respect to severe temperature moisture conditions, and only salt atmosphere conditions decrease their reliability significantly. Semiconductor integrated circuits in epoxy A and phenol housing are more resistant to the impact of salt atmosphere, but are more frequently damaged under the impact of moisture, temperature, and water steam. M.G.

N81-16403# Westinghouse Defense and Electronic Systems Center, Baltimore, Md. Advanced Technology Labs.
A CCD MONOLITHIC LMS ADAPTIVE ANALOG SIGNAL PROCESSOR INTEGRATED CIRCUIT Final Report
Marvin H. White and Ingham A. G. Mack Mar. 1980 114 p refs
(Contract N00173-77-C-0328)

(AD-A092510; Rept-80-0976) Avail: NTIS HC A06/MF A01 CSCL 09/5

This report describes the implementation of a recursive, stochastic algorithm, the Least-Mean-Square (LMS) Error algorithm, in a 16 tap weight CCD monolithic analog adaptive filter with electrically-reprogrammable MOS analog conductance weights. The analog and digital peripheral MOS on-chip circuits are provided with CMOS technology. GRA

N81-16404# Naval Research Lab., Washington, D. C.
EFFECTS OF VELOCITY SPREAD AND WALL RESISTIVITY ON THE GAIN AND BANDWIDTH OF THE GYROTRON TRAVELLING-WAVE AMPLIFIER Interim Report
Y. Y. Lau, K. R. Chu, and L. Barnett 12 Nov. 1980 42 p refs
(XF62581007; XF54581007)
(AD-A092572; NRL-MR-4304) Avail: NTIS HC A03/MF A01 CSCL 09/1

The small signal gain and bandwidth of the gyrotron travelling-wave amplifier (gyro-TWA) operating at the fundamental cyclotron harmonic are examined. The analytical and numerical studies focus on the effects of velocity spread in the electron beam and of a distributed wall resistivity in the waveguide. It is found that wall resistivity reduces the forward gain of the amplifier only by an amount approximately equal to 1/3 of the corresponding cold tube loss. Significant increase in bandwidth may result, under certain conditions, from the presence of wall resistivity. A moderate amount (5-10%) of velocity spread does not reduce the peak gain significantly in general, but may reduce the bandwidth by an amount depending on the applied magnetic field. Based on considerations of such factors as power, stability, gain bandwidth and efficiency, operating parameters for the gyro-TWA are suggested. GRA

N81-16405# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SATELLITE 9441 20 WATT TWTA ANOMALY REPORT Final Report
P. H. Fowler 15 Apr. 1980 20 p refs
(Contract F04701-80-C-0022)
(AD-A092886; TRW-36060-AR-021-01; SD-TR-80-36) Avail: NTIS HC A02/MF A01 CSCL 09/1

This report presents the results of an investigation of the cause of failure of a 20 watt amplifier considering orbital data and laboratory simulation. It ascribes the failure to the power supply (not the tube) and suggests a probable cause. GRA

N81-16406# Edgerton, Germeshausen and Grier, Inc., Goleta, Calif. Energy Measurements Group.
A DISTRIBUTED R-C RADIAL TRANSMISSION LINE THEORY APPLIED TO THE GAIN CHARACTERISTICS OF GATED MICROCHANNEL-PLATE IMAGE INTENSIFIERS
J. I. Detch and J. W. Ogle Jun. 1980 36 p refs
(Contract DE-AC08-76NV-01183)
(EGG-1183-2404; S-699-R) Avail: NTIS HC A03/MF A01

Microchannel plate (MCP) image intensifiers may be gated by the application of appropriate potentials between the photocathode and the microchannel plate structure. The pulse propagation characteristics were modeled as a distributed R-C network having cylindrical symmetry. The propagation characteristics of this network were calculated analytically in terms of an infinite series of J sub 0 and J sub 1 Bessel functions for step function, impulse function and for arbitrary driving functions by convolution. The gain versus voltage characteristics of an MCP are included. The propagation theory is applicable to other structures having similar geometry, such as large grid controlled electron guns. Author

N81-16407# California Univ., Berkeley. Lawrence Berkeley Lab.
PERFORMANCE STUDIES OF HIGH GAIN PHOTOMULTIPLIER HAVING Z-CONFIGURATION OF MICROCHANNEL PLATES
C. C. Lo and B. Leskovar Nov. 1980 10 p refs Presented at 1980 Nucl. Sci. Symp., Orlando, Fla. 5-7 Nov. 1980
(Contract W-7405-eng-58)
(LBL-11028) Avail: NTIS HC A02/MF A01

The characteristics of a high gain type ITT F4129 photomultiplier having three microchannel plates in cascade for electron multiplications were investigated. These plates are in the Z-configuration. Measurements are given of the gain dark current, cathode quantum efficiency, anode pulse linearity, electron transit time, single and multiphoton time spreads, fatigue, and pulse height resolution. The gain as a function of transverse magnetic field was measured and discussed. Photomultiplier characteristics as a function of the input pulse repetition frequency were also investigated and discussed. Author

N81-16408# Westinghouse Electric Corp., Trafford, Pa.
ELECTRONIC CURRENT TRANSDUCER FOR EHV CIRCUITS Final Report
L. E. Berkebile Nov. 1980 154 p refs
(EPRI Proj. 560-1)
(EPRI-EL-1611) Avail: NTIS HC A08/MF A01

An electronic current transducer (ECT) was built and tested in the high voltage, high power laboratory environment. The developed ECT serves both metering and relaying devices and meets, or in some areas exceeds the desired accuracy requirements. The dielectric system consists of a support insulator and fiber optic cables only and should dielectrically be almost as good as a conventional post insulator. A self starting power supply is described that operates within 200 microseconds for fault conditions and most energization transients. The power supply keeps the ECT operating down to 2% of rated current. The ECT incorporates a single fiber optical waveguide, which coveres a distance of 300 meters or more; this is sufficient for most substation yards. R.C.T.

N81-16409# General Atomic Co., San Diego, Calif.
THE 30 MJ SUPERCONDUCTING COIL DESIGN AND FABRICATION
John R. Purcell Sep. 1980 8 p Presented at the Mech., Magnetic, and Underground Energy Storage Ann. Contractors Rev., Washington, D.C., 10-13 Nov. 1980
(Gen. Atomic Proj. 3305)
(LA-UR-80-3407; GA-A16104) Avail: NTIS HC A02/MF A01

The 30 MJ coil is a solenoid with a winding bore of 107 in. It is 48 in. tall and has an outside diameter of 134 inches. Peak field on the conductor is about 2.8 T at full current of 4900 A, and the stored energy is 32 MJ. The total weight of the finished coil is 37,800 pounds. Construction procedures are described. T.M.

N81-16410# National Bureau of Standards, Boulder, Colo. National Engineering Lab.
EVALUATION OF THREE-TERMINAL AND FOUR-TERMINAL PAIR CAPACITORS AT HIGH FREQUENCIES
R. N. Jones Sep. 1980 22 p refs
(PB81-109209; NBS-TN-1024) Avail: NTIS HC A02/MF A01 CSCL 14B

The low frequency (1 kHz) capacitance values of three terminal and four terminal pair air dielectric capacitors can be extrapolated to higher frequencies if the residual series inductance is known. A resonance method for evaluating the residual series inductance of these capacitor types, together with the extrapolation procedure, is described. For the region where the product of capacitance in farads and frequency in hertz is 0.01 or less, uncertainties of one percent or less may be obtained. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N81-16411 California Univ., Berkeley.
THE CALCULATION OF HYDRODYNAMIC FORCES ACTING ON A DEFORMABLE CYLINDER IN FREE SURFACE Ph.D. Thesis
Byung-Kun Yu 1979 85 p

Avail: Univ. Microfilms Order No. 8029636

Boundary value problems associated with the deformation of an infinite cylinder in a free surface are formulated. These problems include vibration in still water and deformation due to wave induced forces. The amplitude of deformation is assumed to be small enough for linear theory to be applicable. The deformation itself is assumed to vary sinusoidally along the length of cylinder and arbitrarily girthwise. With the application of Green's theorem for an unbounded fluid, each boundary value problem results in a Fredholm integral equation of the second kind. The integral equation can be solved numerically using a distribution of oscillatory source Green functions on the periphery of the submerged surface. In this technique, Frank's close fit method is extended to treat non-rigid body deformations. Hydrodynamic pressure distributions created by the arbitrary deformation of a cylinder are calculated. The results show that these hydrodynamic pressures are quite dependent on the shape of the deformation pattern and are also quite sensitive to the longitudinal periodicity. Dissert. Abstr.

N81-16412 California Univ., Berkeley.
A GREEN-FUNCTION METHOD FOR WAVE INTERACTION WITH A SUBMERGED BODY Ph.D. Thesis
Wataru Kioka 1980 129 p
Avail: Univ. Microfilms Order No. 8029455

A numerical method for solving boundary value problems related to potential flows with a free surface is presented. The method determines the hydrodynamic forces exerted on a rigid body oscillating in its six degrees of freedom under a free surface as well as the forces resulting from the wave interaction of the body held fixed. The linearized problem is first formulated for a three dimensional body of general shape in water of finite depth. Application of Green's third identity, using the Green function that satisfies the free surface, bottom and radiation conditions, reduces the problem to the solution of an integral equation with the unknown function being the velocity potential over the body surface. The integral equation is solved numerically by means of a finite-element technique consisting of triangular elements. An approximate Green function which is valid for the case of a relatively deep water is also presented. The numerical procedure is outlined in detail for the bodies fully submerged under the free surface. Dissert. Abstr.

N81-16413*# Stanford Univ., Calif. Thermosciences Div.
TURBULENT BOUNDARY LAYER ON A CONVEX, CURVED SURFACE
J. C. Gillis, J. P. Johnston, W. M. Kays, and R. J. Moffat Sep. 1980 311 p refs
(Grants NsG-3124; NAG3-3)
(NASA-CR-163868 ; HMT-31) Avail: NTIS HC A14/MF A01 CSCL 20D

The effects of strong convex curvature on boundary layer turbulence were investigated. The data gathered on the behavior of Reynolds stress suggested the formulation of a simple turbulence model. Three sets of data were taken on two separate facilities. Both rigs had flow from a flat surface, over a convex surface with 90 deg of turning, and then onto a flat recovery surface. The geometry was adjusted so that, for both rigs, the pressure gradient along the test surface was zero - thus avoiding any effects of streamwise acceleration on the wall layers. Results show that after a sudden introduction of curvature, the shear stress in the outer part of the boundary layer is sharply diminished and is even slightly negative near the edge. The wall shear also drops off quickly downstream. In contrast, when the surface suddenly becomes flat again, the wall shear and shear stress profiles recover very slowly towards flat wall conditions. R.C.T.

N81-16414*# Imperial Coll. of Science and Technology, London (England).
MEASUREMENTS OF LAMINAR AND TURBULENT FLOW IN A CURVED DUCT WITH THIN INLET BOUNDARY LAYERS Final Report
A. M. K. P. Taylor, J. H. Whitelaw, and M. Yianneskis Washington NASA Jan. 1981 62 p refs
(Contract NASw-3258)
(NASA-CR-3367; FS-80-29) Avail: NTIS HC A04/MF A01 CSCL 20D

Laser Doppler velocimetry was used to measure the laminar and turbulent flow in a 90 deg square bend of strong curvature. The boundary layers at the inlet to the bend were approximately 25 percent and 15 percent of the hydraulic diameter for the laminar and turbulent flows, respectively. The development of the pressure driven secondary motion is more rapid for laminar flow: the maximum cross stream component measured was 60 percent of the bulk velocity in contrast to 40 percent for turbulent flow. The streamwise isotachs show that, for laminar flow, large velocities are found progressively nearer to the outer radius of the bend and along the sidewalls. For turbulent flow, the isotachs move towards the inner radius until about 60 deg around the bend where strong secondary motion results in a similar redistribution. Turbulence level and shear stress measurements are also presented. Author

N81-16415*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SUPERFLUID HELIUM LEAK SEALANT STUDY
John W. Vorreiter Jan. 1981 19 p refs
(NASA-TM-81212; A-8233) Avail: NTIS HC A02/MF A01 CSCL 20D

Twenty-one leak specimens were fabricated in the ends of stainless steel and aluminum tubes. Eighteen of these tubes were coated with a copolymer material to seal the leak. The other three specimens were left uncoated and served as control specimens. All 21 tubes were cold shocked in liquid helium 50 times and then the leak rate was measured while the tubes were submerged in superfluid helium at 1.7 K. During the cold shocks two of the coated specimens were mechanically damaged and eliminated from the test program. Of the remaining 16 coated specimens one suffered a total coating failure and resulting high leak rate. Another three of the coated specimens suffered partial coating failures. The leak rates of the uncoated specimens were also measured and reported. The significance of various leak rates is discussed in view of the infrared astronomical satellite (IRAS) Dewar performance. Author

N81-16416*# Lockheed Missiles and Space Co., Huntsville, Ala.
HYPERBOLIC/PARABOLIC DEVELOPMENT FOR THE GIM-STAR CODE Progress Report
L. W. Spradley, J. F. Stalnaker, and A. W. Ratliff Dec. 1980 177 p refs
(Contracts NAS1-15783; NAS1-15795)
(NASA-CR-3369; LMSC-HREC-TR-D697882) Avail: NTIS HC A09/MF A01 CSCL 20D

Flow fields in supersonic inlet configurations were computed using the eliptic GIM code on the STAR computer. Spillage flow under the lower cowl was calculated to be 33% of the incoming stream. The shock/boundary layer interaction on the upper propulsive surface was computed including separation. All shocks produced by the flow system were captured. Linearized block implicit (LBI) schemes were examined to determine their application to the GIM code. Pure explicit methods have stability limitations and fully implicit schemes are inherently inefficient; however, LBI schemes show promise as an effective compromise. A quasiparabolic version of the GIM code was developed using elastical parabolized Navier-Stokes methods combined with quasitime relaxation. This scheme is referred to as quasiparabolic although it applies equally well to hyperbolic supersonic inviscid flows. Second order windward differences are used in the marching coordinate and either explicit or linear block implicit time relaxation can be incorporated. A.R.H.

N81-16417*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CAPILLARY AND ACCELERATION WAVE BREAKUP OF LIQUID JETS IN AXIAL-FLOW AIRSTREAMS
Robert D. Ingebo Jan. 1981 13 p refs
(NASA-TP-1791; E-537) Avail: NTIS HC A02/MF A01 CSCL 20D

Empirical correlations of reciprocal mean drop diameter with airstream momentum were derived from capillary and acceleration wave breakup of liquid jets atomized by cross stream injection into axial flow airstreams. A scanning radiometer was used to obtain data over an airstream momentum range of 3.7 to 25.7 g/sq cm sec. Transition from capillary to acceleration wave

breakup was obtained at a critical Weber-Reynolds number of 1,000,000. E.D.K.

N81-16418*# Florida Univ., Gainesville. Dept. of Engineering Sciences.
VELOCITY FIELD NEAR THE JET ORIFICE OF A ROUND JET IN A CROSSFLOW Interim Report
Richard L. Fearn and J. Paul Benson Dec. 1979 72 p refs (Grants NsG-2288; NGL-10-005-127)
(NASA-CR-152353) Avail: NTIS HC A04/MF A01 CSCL 20D

Experimentally determined velocities at selected locations near the jet orifice are presented and analyzed for a round jet in crossflow. Jet to cross flow velocity ratios of four and eight were studied experimentally for a round subsonic jet of air exhausting perpendicularly through a flat plate into a subsonic crosswind of the same temperature. Velocity measurements were made in cross sections to the jet plume located from one to four jet diameters from the orifice. Jet centerline and vortex properties are presented and utilized to extend the results of a previous study into the region close to the jet orifice. Author

N81-16419# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
EXPERIMENTS ON THE STABILITY OF CONVERGING CYLINDRICAL SHOCK WAVES
James H. T. Wu, Rafik A. Neemeh, and P. Perry Ostrowski (Naval Ordnance Station, Indian Head, Md.) 1 Aug. 1980 26 p refs Backup document for AIAA Synoptic scheduled for publication to AIAA Journal, Mar. or Apr. 1981
(LOG-J11846) Avail: NTIS HC A03/MF A01

A shock tube which employs a series of conical contractions to direct a plane, annular incident shock wave into a cylindrical implosion chamber was used for an incident shock Mach number as low as 1.79. Highly symmetrical implosions at early times were achieved although an eventual breakdown in shock front curvature was always noted at small radius regardless of the initial Mach number. The cylindrical shock Mach number variation and trajectory was found to be well predicted by the Chester-Chisnell-Whitham (CCW) area Mach number relation. Spark shadowgraph photography was used to demonstrate the inherent instability of converging cylindrical shocks by introducing obstacles in the path of the shock, upstream and downstream of the conical contractions. Whitham's ray shock theory was applied to provide an insight into the mechanism of instability associated with perturbed converging shocks. It is shown that a breakdown in shock front curvature is a natural and necessary consequence of initial asymmetries and that this instability phenomenon is signaled by the appearance of clockwise and counter clockwise rotating vortex pairs during the later diverging shock motion. A.R.H.

N81-16420*# City Coll. of the City Univ. of New York.
THEORY OF STRONG TURBULENCE BY RENORMALIZATION Final Technical Report, 15 Jan. 1978 - 14 Jan. 1981
C. M. Tchen 22 Jan. 1981 121 p refs
(Grant NsG-1485)
(NASA-CR-163871) Avail: NTIS HC A06/MF A01 CSCL 20D

The hydrodynamical equations of turbulent motions are inhomogeneous and nonlinear in their inertia and force terms and will generate a hierarchy. A kinetic method was developed to transform the hydrodynamic equations into a master equation governing the velocity distribution, as a function of the time, the position and the velocity as an independent variable. The master equation presents the advantage of being homogeneous and having fewer nonlinear terms and is therefore simpler for the investigation of closure. After the closure by means of a cascade scaling procedure, the kinetic equation is derived and possesses a memory which represents the nonMarkovian character of turbulence. The kinetic equation is transformed back to the hydrodynamical form to yield an energy balance in the cascade form. Normal and anomalous transports are analyzed. The theory is described for incompressible, compressible and plasma turbulence. Applications of the method to problems relating to sound generation and the propagation of light in a nonfrozen turbulence are considered. A.R.H.

N81-16421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF INFLOW VELOCITY PROFILES ON THE PERFORMANCE OF SUPERSONIC EJECTOR NOZZLES
Allan R. Bishop 1981 8 p refs Presented at the 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by AIAA
(NASA-TM-81673; E-697) Avail: NTIS HC A02/MF A01 CSCL 20D

The effect of initial velocity profile on the performance of axisymmetric supersonic ejector nozzles is discussed. Two different initial profiles in each of two different geometries are analyzed, and the importance of using realistic starting conditions to predict supersonic nozzle performance is demonstrated. Author

N81-16422# European Space Agency, Paris (France).
A THEORETICAL INVESTIGATION ON THE EFFECT OF THE PRESSURE STRAIN CORRELATIONS ON THE DEVELOPMENT OF THREE DIMENSIONAL TURBULENT BOUNDARY LAYERS
Julius Christian Rotta Jun. 1980 74 p refs Transl. into ENGLISH of "Eine Theoret. Untersuchung ueber den Einfluss der druckscherkorrelationen aug die Entwicklungdreidimensionaler turbulenter Grenzschichten" DFVLR, Goettingen, West Germany Report DFVLR-FB-79-05, Feb. 1979 Original report in GERMAN previously announced as N80-22654
(ESA-TT-618; DFVLR-FB-79-05) Avail: NTIS HC A04/MF A01; Original German report available from DFVLR, Cologne, DM 11,56

A theoretical investigation of the process of shear stress generation in three dimensional turbulent boundary layers suggests that the mean products of pressure and rate of strain fluctuations contribute substantially to the directional differences of the resultant shear stress and the resultant mean rate of strain. Two approximate relationships are developed and comparative calculations of the turbulent boundary layers on infinite swept wings are carried out, integrating the partial differential equations for the mean velocities and the transport equations for the shear stresses and kinetic energy. The results of two flow cases are compared with available experimental results. Author

N81-16423# Levy (Salomon), Inc., Campbell, Calif.
PREDICTION OF CRITICAL HEAT FLUX FOR ANNULAR FLOW IN VERTICAL PIPES Final Report
S Levy, J. M. Healzer, and D. Abdollahian Nov. 1980 38 p refs Sponsored by Electric Power Research Inst.
(EPRI Proj. 1380-1)
(EPRI-NP-1619) Avail: NTIS HC A03/MF A01

A semiempirical model for adiabatic two phase annular flow is extended to predict critical heat flux in a vertical pipe for conditions of interest to boiling water reactors. The model exhibits a sharply declining curve of critical heat flux versus steam quality at low steam qualities where it is relatively independent of heat flux distribution. In this region, vaporization of the liquid film controls. At high steam qualities, net deposition upon the liquid film becomes important and the critical heat flux versus steam quality flattens considerably. In this zone, the critical heat flux is dependent upon heat flux distribution. Model predictions are compared to test data and an empirical correlation. The agreement is generally good if mass transfer coefficients are used. J.M.S.

N81-16424# California Univ., Berkeley. Materials and Molecular Research Div.
WETTING, SPREADING AND REACTIONS AT LIQUID/SOLID INTERFACES
Joseph A. Pask and Antoni P. Tomsia Jul. 1980 15 p refs Presented at the LBL/MMRD Intern. Mater. Symp., Berkeley, Calif., 28-30 Jul. 1980
(LBL-11335; CONF-800765-4) Avail: NTIS HC A02/MF A01

Chemical reactions of glass metal interfaces are investigated. Chemical (thermodynamic) stable equilibrium at glass metal interfaces is established when the liquid glass becomes saturated with the low valence oxide of the metal. Stable or metastable equilibrium conditions at glass metal interfaces result in a constant contact angle in a sessile drop experiment. If chemical equilibrium is absent, then a driving force exists for the occurrence of a

reaction to attain equilibrium. All reactions that take place contribute to the maintenance of the necessary saturation of the liquid and solid at the interface with the solid substrate oxide in order to realize chemical bonding across the interface. Spreading always occurs when the solid metal is an active participant in these reactions. Examples showing the development of these principles are based on systems of sodium disilicate with Fe, Co, Ni, Fe-Ni alloys, Pt, Ag, Au, Cu, Ta, W, Mo, Nb, Zr and Cr. The final structure and composition of the glass metal interfacial zone are determined by the kinetics and thermodynamics of the reactions that occur. M.G.

N81-16425# Eikonix Corp., Bedford, Mass.
SMALL BUSINESS INNOVATION PROGRAM. PHASE 1: SELECTIVE THERMAL RADIATORS Final Report
Charles R. Hauer 13 May 1980 38 p refs
(Grant NSF DAR-79-17224)
(PB80-225212; EC/2411601; NSF/RA-800128) Avail: NTIS HC A03/MF A01 CSCL 20F

Experiments used ion implantation to modify the radiation and evaporation surface properties of tungsten filaments operating at about 2800 K. Tungsten filaments ion implanted with carbon at low energy showed an ability to dissipate more energy than unimplanted tungsten filaments when operated in parallel prior to filament failure. Infrared reflectance measurements of a blackbody source indicated anomolous behavior, in that the reflectance and emittance of the surface appeared to be a strong function of the wavelength in the vicinity of the period. There appeared to be a concomitant shift toward longer wavelengths in the peak of the reflected blackbody radiance spectrum when a periodically structured reflector was used. GRA

N81-16426 California Univ., Berkeley.
STATISTICAL DYNAMICS OF WEAKLY NONLINEAR INTERNAL WAVES Ph.D. Thesis
James Donald Meiss 1980 122 p
Avail: Univ. Microfilms Order No. 8029502

The Hamiltonian for triad interactions among internal waves in an incompressible, inviscid, rotating, stratified fluid is obtained by expanson of the Lagrangian. The amplitudes of the eigenfunctions of the linear system are used as canonical coordinates. Numerical evidence is presented which indicates that the test wave model, a truncation of the full Hamiltonian, is integrable. The explicit integrals of motion are presented for the case when all triads are resonant and coupling coefficients equals. Application of two Langevin methods yields relaxation rates for the test wave when the ambient wave amplitudes are random and their number is continuously infinite. The relationship between these methods and the radiative transport equation is discussed.
Dissert. Abstr.

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N81-16427*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTAINERLESS MELTING AND RAPID SOLIDIFICATION APPARATUS AND METHOD Patent Application
William A. Oran, inventor (to NASA) Filed 8 Dec. 1980 9 p
(NASA-Case-MFS-25305; US-Patent-Appl-SN-214360) Avail: NTIS HC A02/MF A01 CSCL 14B

A specimen in a closed environment is suspended in a levitating field, melted, and then cooled and solidified by the injection of a quench gas. The apparatus disclosed employs an electromagnetic levitation system and housing which is evacuated by a vacuum pump or supplied with a controlled amount of argon gas from a source through a valve. The levitation system has a coil made of copper tubing and is connected to an induction generator. A supply of quench gas is connected to the housing by a line and valve. After a levitated specimen is melted, quenching gas of high thermal conductivity is rapidly introduced. This raises the pressure from 40 to 400 Torr, which quickly cools and solidifies the specimen. NASA

N81-16428*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MINIATURE DRAG-FORCE ANEMOMETER
L. N. Krause and G. C. Fralick 1981 17 p refs Proposed for presentation at the 2nd Intern. Symp. and Ind., St. Louis, 6-10 Apr. 1981; sponsored by ASME, the ISA and NBS
(NASA-TM-81680; E-706) Avail: NTIS HC A02/MF A01 CSCL 14B

A miniature drag force anemometer is described which is capable of measuring unsteady as well as steady state velocity head and flow direction. It consists of a cantilevered beam with strain gages located at the base of the beam as the force measuring element. The dynamics of the beam are like those of lightly damped second order system with a natural frequency as high as 40 kilohertz depending on beam geometry and material. The anemometer is used in both forward and reversed flow. Anemometer characteristics and several designs are presented along with discussions of several applications. Author

N81-16429*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECIFYING AND CALIBRATING INSTRUMENTATIONS FOR WIDEBAND ELECTRONIC POWER MEASUREMENTS
Daniel J. Lesco and Donald H. Weikle Dec. 1980 20 p refs
(Contract EC-77-A-31-1044)
(NASA-TM-81545; DOE/NASA/1044-8) Avail: NTIS HC A02/MF A01 CSCL 14B

The wideband electric power measurement related topics of electronic wattmeter calibration and specification are discussed. Tested calibration techniques are described in detail. Analytical methods used to determine the bandwidth requirements of instrumentation for switching circuit waveforms are presented and illustrated with examples from electric vehicle type applications. Analog multiplier wattmeters, digital wattmeters and calculating digital oscilloscopes are compared. The instrumentation characteristics which are critical to accurate wideband power measurement are described. J.M.S.

N81-16430# Aeronautical Research Labs., Wright-Patterson AFB, Ohio.
AN IMPROVED FLIGHT DATA TRANSCRIBER
A. J. Farrell Feb. 1980 30 p refs
(AD-A091981; ARL/AERO-TM-318) Avail: NTIS HC A03/MF A01 CSCL 14/3

A unit is described which converts serial data recorded on the MKI or MKII Aero. Division Airborne Data Acquisition Package into a form suitable for recording on 7 track computer compatible tape. It is an improved version of a previous unit designed to work with the MKI Data Acquisition Package. GRA

N81-16431# Air Force Systems Command, Eglin AFB, Fla.
SCALE FACTOR AND NOISE PERFORMANCE TESTS OF THE BENDIX CORPORATION RATE GYRO ASSEMBLY (RGA) Final Report, 29 May - 19 Jun. 1980
Robert Kim and John Hoffman Aug. 1980 213 p
(AF Proj. 921E)
(AD-A092515; AD-E800119; AD-TR-80-63) Avail: NTIS HC A10/MF A01 CSCL 22/2

Three Bendix Corporation gyroscopes in a Rate Gyro Assembly (RGA) were tested at the Central Inertial Guidance Test Facility (CIGTF), 6585th Test Group, Holloman Air Force Base, New Mexico, from 29 May through 19 June 1980, for the National Aeronautics and Space Administration (NASA), Marshall Space Flight Center (MSFC), Huntsville, Alabama. The purpose of the tests was to characterize the noise performance of each gyro in the RGA in the frequency range of 0.01 hertz to 20 hertz. Gyro noise performance was then compared with seismic activity and previous results from Bendix Corporation testing. Eight-point tests were performed to obtain scale factors which were used to scale the Power Spectral Density (PSD) data. The PSD test series consisted of 1, 2.5, 5, 40 and 180 minute tests under various operating conditions (wheels on and off, low and high

rate modes, and horizontal and vertical output axis orientations). The data are presented as PSD plots in the frequency domain. These results show a negligible seismic contribution and are comparable with data obtained at the Bendix test facility. GRA

N81-16432# Princeton Univ., N. J. Plasma Physics Lab.
PDX MULTICHANNEL INTERFEROMETER
R. Bitzer, W. Ernst, and G. Cutogeorge Oct. 1980 40 p refs (Contract DE-AC02-76CH-03073)
(PPPL-1714) Avail: NTIS HC A03/MF A01

A 10 channel, 140 GHz homodyne interferometer is described for use on PDX. One feature of this interferometer is the separation of the signal source and electronics from the power splitters, delay line, and receiving systems. The latter is situated near the upper and lower vacuum ports between the toroidal field magnets. A second feature is the signal stabilization of the EIO source by means of an AFC system. The complete interferometer is described including block diagrams, circuit diagrams, test data, and magnetic field tests conducted on the preamplifiers, microwave diodes, isolators, etc., to determine the extent of magnetic shielding required. The description of the tracking filters and digital phase display circuit is referenced to accompanying reports. Author

N81-16433# Raytheon Service Co., Burlington, Mass.
OPTIMIZING CALIBRATION RECALL INTERVALS AND ALGORITHMS Final Report
12 Aug. 1980 112 p refs
(Contract NBS-79-SBCA-0061)
(PB81-109597; NBS-GCR-80-283) Avail: NTIS HC A06/MF A01 CSCL 14B

Methods used for establishing and/or adjusting calibration intervals within the federal government and private industry are discussed. Each interval method is analyzed in some detail and recommendations of feasibility for use are presented. Data gathered from visits to 230 government and industry calibration laboratories and survey questions received from 51 representative calibration labs in the Federal government are reviewed. GRA

N81-16434# Bureau of Mines, Amarillo, Tex. Helium Operations.
A PROPORTIONAL TEMPERATURE CONTROLLER WITH AUTOMATIC SHUTOFF
George M. Lucich and Philip W. Holland 1980 14 p refs
(PB81-104630; BM-RI-8423) Avail: NTIS HC A02/MF A01 CSCL 14B

A sensitive, proportional temperature controller useful in the temperature range from 40 to 400 C with an accuracy of plus or minus 0.1 C is described. It is potentially useful for regulating temperatures in air chambers, liquid baths, furnaces and reaction vessels and for other applications. This instrument was developed to control the duration and temperature of the heating cycle of a charcoal filled adsorber that is part of a special helium analyzer. The controller was made from commercially available parts and can be easily modified to provide continuous temperature control. The circuit is solid state and employs no electromechanical devices. Over a 2 year period of use as a component of the special helium analyzer, this temperature controller performed successfully and required no maintenance. GRA

N81-16435# Raytheon Service Co., Burlington, Mass.
ALTERNATIVES TO PMTE (PRECISION MEASURING AND TEST EQUIPMENT) OUT-OF-SERVICE CALIBRATIONS WITHIN THE FEDERAL GOVERNMENT Final Report
D. M. Herzmark, L. D. King, J. M. Kluetz, C. E. Moss, and A. L. Plebanek 12 Aug. 1980 98 p
(Contract NBS79-SBCA-0061)
(PB81-110181; NBS-GCR-80-282) Avail: NTIS HC A05/MF A01 CSCL 14B

Various alternatives to out of service calibration within the Federal government and private industry are described. Current calibration practices and recommendations for improvement are presented. Findings and recommendations are based on data gathered from visits to 23 government and industry calibration laboratories and survey questionnaires received from 51 representative calibration labs in the Federal government. GRA

N81-16436 Washington Univ., Seattle.
THE PERFORMANCE OF A CONSTANT-TEMPERATURE HOT-WIRE ANEMOMETER IN A THIN SUPERSONIC TURBULENT BOUNDARY LAYER Ph.D. Thesis
Edward Patrick McDaid 1980 329 p
Avail: Univ. Microfilms Order No. 8029779

The performance of a constant temperature hot wire anemometer operating in a thin supersonic turbulent boundary layer was assessed. The sensor was mounted normal to the flow and the ends of the sensor were welded directly to its structural supports. Problems deriving from the thermal boundary conditions and limited frequency response of the sensor were investigated. A general numerical model was implemented for calculating the linearized response of the local wire temperature fluctuations about the solution to the mean nonlinear one dimensional heat transfer equation for conduction and convection. This model was used to obtain an ordering of the accuracies of several existing methods for estimating the sensitivity to total temperature. Estimates were also obtained for the differences between the frequency responses of the instrument to its several input variables. This numerical study indicates that an accurate spectral analysis requires the inclusion of these differences. An additional result is that quasistatic calibrations yield sensitivities which are significantly different than those applicable to the analysis of dynamic turbulence data. Dissert. Abstr.

36 LASERS AND MASERS

Includes parametric amplifiers.

N81-16437*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SOLAR-PUMPED GAS LASER DEVELOPMENT
John W. Wilson Dec. 1980 66 p refs
(NASA-TM-81894) Avail: NTIS HC A04/MF A01 CSCL 20E

A survey of gas properties through detailed kinetic models led to the identification of critical gas parameters for use in choosing appropriate gas combinations for solar pumped lasers. Broadband photoabsorption in the visible or near UV range is required to excite large volumes of gas and to insure good solar absorption efficiency. The photoexcitation density is independent of the absorption bandwidth. The state excited must be a metastable state which is not quenched by the parent gas. The emission bandwidth must be less than 10 A to insure lasing threshold over reasonable gain lengths. The system should show a high degree of chemical reversibility and an insensitivity to increasing temperature. Other properties such as good quantum efficiency and kinetic efficiency are also implied. Although photoexcitation of electronic vibrational transitions is considered as a possible system if the emission bands sufficiently narrow, it appears that photodissociation into atomic metastables is more likely to result in a successful solar pumped laser system. J.M.S.

N81-16438# Stanford Univ., Calif. High Energy Physics Lab.
DESIGN STUDY OF A FREE ELECTRON LASER STORAGE RING
Helmut Wiedmann Jun. 1980 42 p refs
(AD-A092795; SU-HEPL-TN-80-8) Avail: NTIS HC A03/MF A01 CSCL 20/5

The results of a design study for a free electron laser storage ring are discussed. The goal of the study was to show the feasibility of a storage ring beam to be used as the driver for a free electron laser. The requirements for such a storage ring in many respects are more demanding than the parameters of colliding beam storage rings; however, experience and results of many fundamental studies on existing storage rings give us confidence that none of the parameters required for a free electron laser storage ring exceeds the technical possibilities. In fact it was found that the storage ring parameters are well within the state of the art and still leave significant freedom for further optimization. Some of the most characteristic storage ring parameters as obtained in this design study are listed in a table. GRA

N81-16439# Naval Research Lab., Washington, D. C.
PHYSICAL LIMITATIONS AND DESIGN CRITERIA FOR A SOLID STATE GYROTRON Interim Report

A. K. Ganguly and D. C. Webb 24 Oct. 1980 21 p refs
(RR0210346)
(AD-A092150; NRL-8418) Avail: NTIS HC A02/MF A01 CSCL 20/5

Scaling of conventional microwave sources to operate in the near millimeter wave (100-1000 GHz) portion of the electromagnetic spectrum is difficult and often impossible. Severe fabrication and heat dissipation problems are common. In the microwave tube area, workers at the Naval Research Laboratory and elsewhere have shown that the severity of these problems can be considerably reduced by employing the electromagnetically large gyrotron configuration, and kilowatts of continuous power have been generated at millimeter wavelengths. In this report we investigate the possibility of applying similar design principles to the development of solid-state gyrotron. In this report we review the physical mechanism that gives rise to oscillations and present the underlying mathematics. Numerous nonideal factors are considered; namely, a finite electron mean-free-path, injection of electrons which are not monoenergetic, metallic and dielectric ohmic losses in the resonant cavity, and presence of a finite electric field in the interaction region. Use of a reverse-biased Schottky tunnel barrier for electron injection is analyzed in detail and is found to be a promising structure for producing sufficient current to sustain oscillations. Calculations are based on InSb parameters, as this material appears best for this application because of its long mean-free path. The main conclusions of this study are that (a) with available materials it is unlikely that oscillations can be sustained; and (b) with three to five fold increase in the mean-free-path, oscillations appear possible, albeit at a very high frequency (approx. 1000 GHz). GRA

N81-16440# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
STUDY OF GAS DYNAMIC EFFECTS IN NON-UNIFORM HIGH PRESSURE ELECTRICAL DISCHARGES Progress Report, 27 May - 2 Aug. 1980
Jon L. Barto Aug. 1980 90 p refs
(RR0000110)
(AD-A092413; NPS67-80-005) Avail: NTIS HC A05/MF A01 CSCL 20/3

This report examines gas dynamic stabilization of high pressure, highly non-uniform electrical discharges for two electrode geometries. The geometries studied are the multiple-point to plane and the multiple-wire to plane. A successful analytical model is developed utilizing the anode extension concept, which describes the interaction and stabilizing effects of flow, separating the effects of convection and turbulence, in the point-plane geometry. Comparisons of theory and data are presented, illustrating actual observed and calculated breakdown voltages and currents for a number of cases. Flow stabilized high power density electric discharges are applicable to high power electric discharge lasers, magnetohydrodynamic power generation, and other new systems and technologies. GRA

N81-16441# General Electric Co., Philadelphia, Pa. Space Div.
DESIGN STUDY FOR GROUND-BASED ATMOSPHERIC LIDAR SYSTEM Final Report, 29 Feb. - 29 Sep. 1980
R. L. Franklin, G. W. Bethke, and L. W. Springer Hanscom AFB, Mass. AFGL 29 Sep. 1980 225 p refs
(Contract F19628-80-C-0062; AF Proj. 6690)
(AD-A091955; AFGL-TR-80-0264) Avail: NTIS HC A10/MF A01 CSCL 04/1

The Ground-Based Atmospheric Lidar System (G-BALS) is a two-color lidar configuration which provides simultaneous measurements of light backscatter from laser wavelengths at 532 nm (green) and 355 nm (near UV). Light scatter measurements are implemented through photon counting for both the Rayleigh and Mie scatter phenomena. The system includes on-site data processing/reduction to obtain atmospheric molecular density and haze characteristics in the altitude region from 20 to 97 kilometers. GRA

N81-16442# SRI International Corp., Arlington, Va.
THEORY OF THE TRANSVERSE GRADIENT WIGGLER
Norman M. Kroll, Phillip Morton, and Marshall N. Rosenbluth Sep. 1980 47 p refs
(Contract MDA903-78-C-0086; ARPA Order 2504)
(AD-A092212) Avail: NTIS HC A03/MF A01 CSCL 20/5

The use of a free electron laser (FEL) with a transverse field gradient was proposed to prevent the energy spreading and determining which saturates the ordinary FEL. The basic idea is that the transverse field gradient acts as a spectrometer so that as an electron's energy charges due to interaction with radiation it is focused to a different transverse position. One then arranges the transverse field gradient so that the resonance condition remains satisfied at all transverse positions. We will concentrate on the possibility of obtaining high extraction from such a magnet. GRA

N81-16443# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF PLASMA PROCESSES IN ELECTRONIC TRANSITION LASERS Technical Report, 1 Nov. 1979 - 1 Nov. 1980
William L. Nighan 1 Nov. 1980 80 p refs Submitted for publication
(Contract N00014-76-C-0847)
(AD-A091903; UTRC/R80-922617-5) Avail: NTIS HC A05/MF A01 CSCL 20/5

This report describes the essential features of electron-beam controlled discharges of the type common to rare gas halide and mercury-halide lasers. Particular attention is directed toward the XeCl (308 nm) laser using HCl as the halogen donor and the HgBr(502 nm) laser using HgBr2. The basic kinetic processes controlling the behavior of these lasers are discussed with special emphasis on electron collisions with HCl and HgBr2, respectively. GRA

N81-16444# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESIGN CONSIDERATIONS FOR THE INFRARED AIRBORNE RADAR (IRAR) MTI SUBSYSTEM
Robert C. Harney 21 Jul. 1980 92 p refs
(Contract F19628-80-C-0002; AF Proj. 649L)
(AD-A091927; TST-26; ESD-TR-80-83) Avail: NTIS HC A05/MF A01 CSCL 17/5

A design for a moving target indication (MTI) subsystem for the infrared airborne radar (IRAR) is investigated. A Doppler MTI system incorporating heterodyne detection and a CW CO2 laser is determined to be the most suitable approach. Numerous analyses of topics including field-of-view coverage, Doppler resolution, signal-to-noise ratio, clutter effects, etc., are presented which serve to define component specifications and processing requirements. The potential architecture of the MTI system is discussed and the impact of developing technologies on system and component design is estimated. GRA

N81-16445# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
ONE- AND TWO-PHOTON OPTICALLY PUMPED LASER DEVICES' NEW CHEMICAL LASER DIAGNOSTICS AND KINETIC PROBES Final Report, 15 Jun. 1976 - 31 Aug. 1980
Robert W. Field 1 Sep. 1980 10 p refs
(Grant AF-AFOSR-3056-76; AF Proj. 2303)
(AD-A092189; AFOSR-80-1143TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

Research programs in four general areas have resulted in publication of 16 papers, with 10 more in preparation. These areas include: optically pumped I2 B-X electronic transition laser; laser spectroscopy of alkaline earth halides; development of a new technique, Stimulated Emission Pumping, by which highly excited vibrational levels of combustion species may be selectively prepared and examined; optically pumped Na2 B-X laser. GRA

N81-16446# Chicago Univ., Ill.
GAS SURFACE DYNAMICS, HIGH POWER LASER-SOLID INTERACTIONS Final Report, 1 Jan. 1978 - 31 Dec. 1979
Lennard Wharton 6 Oct. 1980 11 p refs
(Grant AF-AFOSR-3186-77; AF Proj. 2303)
(AD-A092183; AFOSR-80-1114TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

This work is a continuation of studies of fundamental aspects of the dynamics of chemical and physical processes on surfaces. The use of pulsed molecular beams and pulsed laser energy beams to initiate and probe energy exchange and chemical

reactions that occur between gases and metal surfaces has been made in experimental studies. The product species and translational kinetic energies are determined with the aid of a mass spectrometer capable of determining the time of arrival of these species. These studies are relevant to the effects of high power laser beams on surfaces. Studies included the following gases: N2, O2, CO, H2, Ar, He, Ne, Xe, and the following surfaces W, Pt, Pt(III). GRA

N81-16447# Harry Diamond Labs., Adelphi, Md.
UNSTABLE-RESONATOR AND OUTPUT-COUPLING DESIGN STUDY FOR DIFFRACTION RADIATION GENERATOR NEAR-MILLIMETER SOURCES
Colin S. Willett Oct. 1980 26 p refs
(DA Proj. 1L1-61101-A-91A)
(AD-A092502; HDL-TR-1936) Avail: NTIS HC A02/MF A01 CSCL 20/5

Configurations of unstable resonators that could be used for diffraction radiation generators (DRG's) are presented. The output coupling of a negative branch unstable resonator exhibits an extreme sensitivity to mirror radius and appears to be unsuited to DRG use. The positive branch resonator does not exhibit this sensitivity to mirror radius and the mirror radii that are needed to give diffraction output couplings of a few percent are practical. GRA

N81-16448# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A 20 YEARS' SURVEY OF LASER SCIENCE AND TECHNOLOGY IN CHINA, II
Ji Zhong and Qun Li 22 Oct. 1980 44 p refs Transl. into ENGLISH from Laser Journal (China), v. 7, no. 2, Feb. 1980 p 1-13
(AD-A092097; FTD-ID(RS)T-1190-80) Avail: NTIS HC A03/MF A01 CSCL 20/5

The technological development and manufacture of various elements, such as laser working materials, light sources, and reflecting film, is described. It is shown that these elements have direct effects on the performance of lasers. It is further shown that a broadened research effort of laser elements to improve their quality is of key importance in widening the lasers applications. R.C.T.

N81-16449# Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistics Research Lab.
FRANCK-CONDON FACTORS FOR THE B-X SYSTEM OF DIATOMIC SULFUR
William R. Anderson, John E. Allen, Jr., and David R. Crosley Aug. 1980 43 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A092376; AD-E430527; ARBRL-TR-02262) Avail: NTIS HC A03/MF A01 CSCL 20/5

A frequency doubled tunable dye laser has been used to selectively excite individual vibrational levels within v-2 and 6-9 of the B-state of diatomic sulfur. Measurements of the intensity in emission of all the terms returning to ground state vibrational levels permit the determination of absolute Franck-Condon factors. Combined with previous studies, this work completes the set of Franck-Condon factors for bound-bound transitions within the B-X system. GRA

N81-16450# Army Missile Command, Redstone Arsenal, Ala. Directed Energy Directorate.
PROPOSED NUCLEAR PUMPED LASER EXPERIMENTS UTILIZING GAMMA-RAYS
Dennis R. Womack and Thomas G. Miller 25 Feb. 1980 34 p refs
(DA Proj. 1L1-61102-AH-49)
(AD-A091883; AD-E950036; DRSMI/RH-80-3-TR) Avail: NTIS HC A03/MF A01 CSCL 20/5

Two experiments are described which use a different approach to nuclear pumped lasers. Gamma-rays will be used to attempt lasing on the C yields A transition in the XeF excimer. One experiment will use the gamma-rays to directly pump a high pressure laser mixture, and the other experiment will use gamma-rays to create photons which will in turn photolytically pump an XeF2 laser mixture. Cell design is described and first-order energy deposition calculations are presented. Predicted energy outputs from half-liter laser cells are 17.0 J for the photolytic experiment, and 1.0 J for the direct gamma experiment. GRA

N81-16451# City Univ. of New York, N. Y. Dept. of Physics.
LASER AND OPTICAL PHYSICS Final Report, 2 Nov. 1975 - 20 Jul. 1980
M. Lax Oct. 1980 15 p refs Prepared in cooperation with Bell Telephone Labs., Murray Hill, N.J.
(Contract DAAG29-79-C-0149)
(AD-A092657; ARO-13410.21-P) Avail: NTIS HC A02/MF A01 CSCL 20/5

Research reported herein has dealt with problems concerning electromagnetic interactions with matter. On the one hand, it has been concerned with the operation of lasers themselves - particularly at high powers. On the other hand, it has been concerned with laser interactions with matter as a means of studying the matter itself and its polarization carrying excitations. GRA

N81-16452# Missouri Univ., St. Louis. Dept. of Physics.
POTENTIAL LASER ACTION IN He-METAL VAPOR MIXTURES
Jacob J. Leventhal 1 Nov. 1980 2 p refs
(Contract N00014-76-C-0760)
(AD-A092599; Rept-4) Avail: NTIS HC A02/MF A01 CSCL 20/5

Cross sections for excited state production in ion-molecule collisions have been measured by observing radiation resulting from decay of the excited species. Recent work involving collisions of He++ with Li is discussed. GRA

N81-16453# Technion - Israel Inst. of Tech., Haifa.
EFFECTS OF COOPERATIVE ATOMIC BEHAVIOR ON LASERS Final Technical Report
I. R. Senitzky Sep. 1980 29 p refs
(Grant DA-ERO-77-G-077)
(AD-A092622) Avail: NTIS HC A03/MF A01 CSCL 20/5

The effect of cooperative behavior, both with respect to pumping and relaxation, on a number of three-level atomic systems which are assumed to have a dipole moment at all three transition frequencies, is analyzed. The atoms are coupled to two cavity modes resonant at the two intermediate frequencies and pumped coherently at the highest frequency. For sufficiently strong pumping, three steady states are shown to exist, the stability of which depends on the pumping strength and the cavity losses. Transition from one steady state to another produces modulated field pulses in both modes, with the phase of the modulation envelopes as well as the phase of the fields being synchronized. Conditions for the generation of various types of pulses are investigated. A generalization that takes into account pump losses due to atomic reaction is introduced and the effect of these losses is studied. GRA

N81-16454# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Missile Structures Directorate.
LASER SPECKLE INTERFEROMETRIC THERMOELASTICITY
John A. Schaeffel, Jr. 30 May 1980 109 p refs
(AD-A092638; AD-E950050; DRSMI/RL-80-9-TR) Avail: NTIS HC A06/MF A01 CSCL 20/13

This report presents the theory for using laser speckle interferometry for making measurements in thermoelasticity problems. General thermoelastic theory, laser speckle interferometric theory, thermal stress deformation of thin plates, and numerical approximations to the thermostress equations are all projected. Two experimental examples are presented which involve the heating of a circular flat plate and the uniform heating of a metallic bar. Interferometrically obtained temperature measurements are compared with thermocouple data. GRA

N81-16455# Naval Research Lab., Washington, D. C. Optical Sciences Div.
LASER-EXTINCTION AND HIGH-RESOLUTION ATMOSPHERIC TRANSMISSION MEASUREMENTS CONDUCTED AT WHITE SANDS MISSILE RANGE, NEW MEXICO Final Report, Mar. 1979
J. A. Dowling, S. T. Hanley, J. A. Curcio, C. O. Gott, and M. A.

Woytko 19 Nov. 1980 57 p refs
(Contract AFOSR MIPR ASL 8016-79)
(AD-A092702; NRL-8446) Avail: NTIS HC A04/MF A01 CSCL 20/14

Measurements of atmospheric transmission over a 6.4 km path were conducted in March 1979 at White Sands Missile Range (WSMR), New Mexico. A deuterium fluoride (DF) laser and a high-resolution Fourier transform spectrometer (FTS) system were used to generate high-quality transmission spectra of the 6.4 km path accurate to + or - 3% in absolute transmission. Details of the procedures used and results obtained in the absolute transmission calibration of the spectra are presented. Path integral values for HDO, H2O, CH4, and N2O concentrations have been derived from the spectra and results of this analysis are described. Comparisons of measured DF laser extinction coefficients with calculated molecular absorption values are presented which show very small aerosol attenuations, generally 1/0.02 km at DF laser wavelengths. Visibilities measured at 0.55 micrometer during the course of the experiment generally averaged over 100 km. GRA

N81-16456# KMS Fusion, Inc., Ann Arbor, Mich.
THE CHEMICALLY PUMPED IODINE LASER AS A FUSION DRIVER
George E. Busch 1980 4 p refs
(Contract DE-AC08-78DP-40030)
(KMSF-U-944; CONF-800208-19) Avail: NTIS HC A02/MF A01

A chemically pumped iodine laser is evaluated for fusion requirements. Efficiencies greater than 8 percent and long energy storage times are predicted, with high repetition rates and elimination of pulsed power supplies. Author

N81-16457# Brookhaven National Lab., Upton, N. Y.
A THREE DIMENSIONAL CALCULATION OF ELECTRON ENERGY LOSS IN A VARIABLE PARAMETER FREE-ELECTRON LASER
Alfredo Luccio and Claudio Pellegrini 1980 19 p refs Presented at 1980 Erice Course on Phys. and Technol. of Free Electron Lasers; sponsored by International School on Quantum Electronics Submitted for publication Sponsored by DOE
(BNL-28339) Avail: NTIS HC A02/MF A01

The motion of an electron beam through a longitudinally varying period undulator for a single-pass free electron laser is studied. It is shown that, under certain conditions, the electrons are trapped in an optical bucket and deliver on the average more energy to the laser field than in constant period undulators of comparable parameters. The limits set by a finite beam emittance and energy spread are studied in detail by three dimensional computer simulation. R.C.T.

N81-16458# R and D Associates, Marina Del Rey, Calif.
FREE-BOUND AND BOUND-BOUND RADIATIVE TRANSITIONS IN AN INTENSE LASER FIELD
L. Schlessinger and J. A. Wright Jul. 1980 30 p refs Sponsored by DOE Prepared for California Univ., Livermore Lawrence Livermore Lab.
(UCRL-15295) Avail: NTIS HC A03/MF A01

The transition rates for free-bound and bound-bound radiative absorption and emission in an intense laser field were calculated. In the approximations used here, the rates were represented by the product of two functions. One function, which contains all the details of the atomic structure, was independent of the laser field. The other function contained all the corrections caused by the intense laser field. The calculations were done using first order perturbation theory to describe the effects of the intense laser field on the bound state levels and using a low frequency approximation for the laser field. It is shown that both these approximations are quite good for the states and laser intensities of interest. The intense field correction factor for the rate of bound-free transitions for electrons with a Boltzmann distribution of energies was calculated. Numerical results for the correction factor for the Boltzmann case are presented. R.C.T.

N81-16459# Los Alamos Scientific Lab., N. Mex.
BORON TRICHLORIDE PURIFICATION WITH A KrF EXCIMER LASER
R. C. Hyer 1980 12 p refs Presented at the Intern. Conf. on Lasers, New Orleans, 14-19 Dec. 1980
(Contract W-7405-eng-36)
(LA-UR-80-3377; CONF-801201-2) Avail: NTIS HC A02/MF A01

Selective ultraviolet photolysis using a KrF excimer laser was used to substantially reduce the phosgene impurity in a binary mixture of boron trichloride and phosgene. Infrared spectroscopic analysis of the sample before and after irradiation shows that it is possible to highly purify commercially available boron trichloride with the technique. Author

N81-16460# California Univ., Livermore. Lawrence Livermore Lab.
ATOMIC VAPOR LASER ISOTOPE SEPARATION AT LAWRENCE LIVERMORE NATIONAL LABORATORY Status Report
James I. Davis 1980 18 p refs Presented at Conf. on Laser and Electro-Opt. Systems, San Diego, Calif. 26-28 Feb. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-83516; CONF-800208-25) Avail: NTIS HC A02/MF A01

The field of laser induced chemistry began in earnest with the initiation of major efforts in laser isotope separation (LIS) of uranium. Though many specialized, small-scale photochemical and diagnostic applications have been identified and evaluated experimentally, and continue to show promise, currently the only high payoff, large-scale applications remain. Aspects of the physical scaling, technology status and economic basis of uranium LIS are considered with special emphasis on the effort at LLNL. Author

N81-16461# California Univ., Livermore. Lawrence Livermore Lab.
INTENSIFICATION OF RARE GAS HALIDE LASERS WITH APPLICATION TO LASER FUSION
R. R. Jacobs, D. Eimerl, J. Goldhar, J. R. Murray, W. R. Rapoport, L. Schlitt, and J. C. Swingle 1980 19 p refs Presented at Optical Eng. Proc. of the 1980 European Conf. on Optical Systems and Appl., Utrecht, The Netherlands, 23-25 Sep. 1980
(Contract W-7405-eng-48)
(UCRL-84082; CONF-800965-1) Avail: NTIS HC A02/MF A01

The two techniques of backward wave Raman pulse compression and pulse stacking are reviewed in the context of using KrF lasers as drivers in inertial confinement fusion. Experimental and theoretical results on Raman pulse compression in methane are presented including data on 70-75% pump energy extraction by the counterpropagating Stokes wave. Results from ongoing pulse stacker/Raman compressor experiments are also described, along with future investigations in this general area. Author

N81-16462# California Univ., Livermore. Lawrence Livermore Lab.
A PARAMETRIC STUDY OF A TARGET FACTORY FOR LASER FUSION
J. W. Sherohman and W. R. Meier 8 Oct. 1980 36 p ref Presented at Am. Nucl. Soc. Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14-17 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84264; CONF-801011-78) Avail: NTIS HC A03/MF A01

An analysis of a target factory is presented which leads to the derivation of production rate equations. Rate equations describing the production of laser fusion targets are developed for the purpose of identifying key parameters, attractive production techniques and cost scaling relationships for a commercial target factory. R.C.T.

N81-16463# California Univ., Livermore. Lawrence Livermore Lab.
EVOLUTION OF SHIVA LASER ALIGNMENT SYSTEMS
Robert D. Boyd Jul. 1980 9 p refs Presented at SPIE, 24th Ann. Tech. Symp., San Diego, Calif., 28 Jul. - 1 Aug. 1980 Submitted for publication: Sponsored by DOE
(UCRL-84008; CONF-800719-9) Avail: NTIS HC A02/MF A01

The development and fabrication of the Shiva laser system

is described. Three alignment systems are emphasized: the oscillator alignment system, which aligns each of the laser's three oscillators to a reference beamline; the chain input pointing system, which points each beam into its respective chain; and the chain output pointing, focusing and centering system which points, centers and focuses the beam onto the target. R.C.T.

N81-16464# California Univ., Livermore. Lawrence Livermore Lab.
MECHANICAL TECHNOLOGY UNIQUE TO LASER FUSION EXPERIMENTAL SYSTEMS
C. A. Hurley 3 Sep. 1980 12 p refs Presented at the 11th Symp. on Fusion Technol., Oxford, 15-19 Sep. 1980 Submitted for publication Sponsored by DOE
(UCRL-84052; CONF-800950-3) Avail: NTIS HC A02/MF A01

Hardware design for laser fusion experimental machines leads to a combination of engineering technologies that are critical to the successful operation of these machines. These large optomechanical systems are dependent on extreme cleanliness, accommodation to efficient maintenance, and high stability. These three technologies are the primary mechanical engineering criteria for laser fusion devices. Author

N81-16465# Sandia Labs., Albuquerque, N. Mex.
LASER-ANNEALED GAP OHMIC CONTACTS FOR HIGH TEMPERATURE DEVICES
O. Eknoyan (Texas A and M Univ., College Station) and J. A. Coquat 1980 6 p refs Sponsored by DOE
(SAND-80-2679C; CONF-801124-25) Avail: NTIS HC A02/MF A01

Ohmic contacts were successfully annealed on n-type GaP. Identical laser and thermal annealed contacts on the same substance were compared and aging was investigated. The results indicate that laser annealed contacts have far superior electrical characteristics, much better surface morphology and are substantially more stable with aging than the same but thermally alloyed ones. A.R.H.

N81-16466# Honeywell Corporate Technology Center, Bloomington, Minn.
DEVELOPMENT OF FLUORIDES FOR HIGH-POWER LASER OPTICS Final Report, 27 Jun. - 30 Sep. 1980
J. F. Ready and H. Vora Sep. 1980 21 p refs Sponsored by DOE
(UCRL-15298) Avail: NTIS HC A02/MF A01

Development of forging processes that permit large scale deformation of LiF without degradation of optical properties is required for potential application of this material as an optical element in laser systems generating short intense pulses in the ultraviolet to heat targets for laser fusion. Forging processes are described that permit deformation of nearly 90% without introducing internal cloudiness in LiF. Mechanical and optical properties of LiF forged using these processes are also discussed, including the microyield and microcreep at room temperatures. R.C.T.

N81-16467# National Technical Information Service, Springfield, Va.
CARBON DIOXIDE LASERS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1978 - Aug. 1980
Diane M. Cavagnaro Oct. 1980 220 p Supersedes NTIS/PS-79/1068; NTIS/PS-78/0896
(PB81-800088; NTIS/PS-79/1068; NTIS/PS-78/0896) Avail: NTIS HC $30.00/MF $30.00 CSCL 20E

Citations on theory, design, operation, output and diagnostics of CO2 lasers are presented. Studies relating to excitation, frequency conversion, modulation, laser pumping, reaction kinetics, gas dynamics, and plasmas are included. The development and efficiency of optical components such as mirrors, resonators, tuning devices, infrared optical materials, amplifiers, and gratings are also discussed. This updated bibliography contains 214 citations, 70 of which are new entries to the previous edition. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N81-16468*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A METHOD AND TECHNIQUE FOR INSTALLING LIGHT-WEIGHT FRAGILE, HIGH-TEMPERATURE FIBER INSULATION Patent Application
Bhanu C. Patel, inventor (to NASA) (Rockwell International Corp., Downey, Calif.) Filed 11 Sep. 1980 10 p Sponsored by NASA
(NASA-Case-MSC-16934-2; US-Patent-Appl-SN-185868) Avail: NTIS HC A02/MF A01 CSCL 13I

Light weight insulation batting such as alumina/zirconia or preferably saffil high temperature insulation such as alumina fiber is precut into oversize elongated solution and compressed in a mold to the required thickness or cross sectional dimensions. The saturated batting is then dried in the mold and the resin cured at an appropriate temperature. The resulting rigidized batting may then be machined to the particular required shape and dimensions for installation in wiremesh sleeving or any cavity requiring heat barrier sealing. The entire assembly is subsequently heated to a temperature much greater than the resin curing temperature to effect a clean burn-off of the resin material leaving the original mineral batting material to expand into the interior shape of the containing cavity or wiremesh sleeving if such insulation is to be used as a heat seal around an openable door or hatch in a recoverable space vehicle. NASA

N81-16469*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LINEAR MAGNETIC BEARINGS Patent Application
Michael P. Goldowsky, inventor (to NASA) (North American Phillips Corp., Tarrytown, N.Y.) Filed 24 Dec. 1980 18 p Sponsored by NASA
(NASA-Case-GSC-12582-1; US-Patent-Appl-SN-220213) Avail: NTIS HC A02/MF A01 CSCL 13I

A linear armature member is magnetically suspended by a bearing which includes an elongated cylindrical housing having two sets of U-shaped stationary electromagnets and position sensors respectively located at each end of the housing. Each set of electromagnets consists of four electromagnet assemblies 90 deg apart around the periphery of the housing and are operable to generate four orthogonal magnetic fields within the housing. Each set of position sensors is aligned with the electromagnets to define two orthogonal horizontal and vertical axes from which signals proportional to orthogonal shaft displacement are provided. These signals are fed to four separate drive circuits which are adapted to provide signals proportional to shaft positional displacement and velocity within the housing and which generate control signals of the proper amplitude and direction to energize the coal windings in order to axially center the shaft within the housing while maintaining a predetermined stiffness and dampening characteristic. A bumper magnet assembly is located at one end of the housing to dampen any axial displacement of the armature member. NASA

N81-16470*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HOLDING FIXTURE FOR A HOT STAMPING PRESS Patent Application
Raymond P. Harris, inventor (to NASA) Filed 16 Jan. 1981 15 p
(NASA-Case-GSC-12619-1; US-Patent-Appl-SN-225499) Avail: NTIS HC A02/MF A01 CSCL 13I

A hand held guide for manually positioning a workpiece between the anvil rib and tool of a hot die stamping press is described. A groove completed by interchangable cover plates attached at one end of the guide conforms to a cross sectional dimension common to similar workpieces and, with a force fit, retentively holds each of the workpieces. NASA

N81-16471*# Illinois Univ. at Urbana-Champaign, Urbana.
TRANSIENT DYNAMIC ANALYSIS OF HIGH-SPEED

LIGHTLY LOADED CYLINDRICAL ROLLER BEARINGS. 1: ANALYSIS Final Report
Thomas F. Conry Washington NASA Jan. 1981 83 p refs (Grant NsG-3098)
(NASA-CR-3334) Avail: NTIS HC A05/MF A01 CSCL 13I

The governing differential equations of motion for a high speed cylindrical roller bearing are developed under the assumptions that the bearing is isothermal and that the roller tilt and skew are very small. Two sets of differential equations are presented: the first which deals with planar motion of the roller bearing system; and the second which includes the effect of roller skewing. The equations as presented are in a format for programming on a digital computer. Author

N81-16472*# Illinois Univ. at Urbana-Champaign, Urbana.
TRANSIENT DYNAMIC ANALYSIS OF HIGH-SPEED LIGHTLY LOADED CYLINDRICAL ROLLER BEARINGS. 2: COMPUTER PROGRAM AND RESULTS Final Report
Thomas F. Conry and Peter R. Goglia Washington Jan. 1981 62 p refs
(Grant NsG-3098)
(NASA-CR-3335) Avail: NTIS HC A04/MF A01 CSCL 13I

The governing differential equations of motion for a high speed cylindrical roller bearing are programmed for numerical solution and plotted output. This computer program has the capability of performing a two dimensional or three dimensional simulation. Two numerical solutions of the governing differential equations were obtained to simulate the motion of a roller bearing, one for the two dimensional equations of motion and one for the three dimensional equations of motion. Computer generated plots were obtained and present such data as roller/cage interaction forces, roller/race traction forces, roller/race relative slip velocities and cage angular speed over a nondimensional time equivalent to 1.2 revolutions of the inner race. Roller axial displacement, roller skew angle, and skew moment are also plotted for the three dimensional solution. The trajectory of the cage center is plotted for both the two dimensional and three dimensional solutions. Author

N81-16473*# California State Univ., Northridge.
ROLLER SKEWING MEASUREMENTS IN CYLINDRICAL ROLLER BEARINGS Final Report
Lester J. Nypan Jan. 1981 106 p refs
(Grant NsG-3065)
(NASA-CR-3381) Avail: NTIS HC A06/MF A01 CSCL 13I

Measurements of roller skewing in a 118 mm bore roller bearing operating at shaft speeds to 12,000 rpm are reported. High speed motion pictures of a modified roller were taken through a derotation prism to record skewing as the roller moved through loaded and unloaded regions of the bearing. Subsequent frame by frame measurement of the photographic film provided information on roller skewing. Radial and tangential skew amplitudes of 0.4 to 0.5 degrees were observed with 0.5 degree misalignment. Author

N81-16474*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELF-ACTING GEOMETRY FOR NONCONTACT SEALS
G. P. Allen 1981 19 p refs Proposed for presentation at Ann. Meeting of ASLE Pittsburgh, 11-14 May 1981
(NASA-TM-81659; E-473) Avail: NTIS HC A02/MF A01 CSCL 11A

Performance ot two self acting seal designs for a liquid oxygen (LOX) turbopump was predicted over ranges of pressure differential and speed. Predictions were compared with test results. Performance of a radial face seal for LOX was predicted up to 448 N/cu cm and 147 m/sec. Performance of a segmented circumferential seal for helium was predicted up to 69 N/cu cm and 189 m/sec. Results confirmed predictions of noncontact operation. Qualitative agreement between test and analysis was found. The LOX face seal evidently operated with mostly liquid in the self acting geometry and mostly gas across the dam. Author

N81-16475*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN EVALUATION OF GREASE TYPE BALL BEARING LUBRICANTS OPERATING IN VARIOUS ENVIRONMENTS Status Report No. 5
E. L. McMurtrey Jan. 1981 24 p refs
(NASA-TM-82391; SR-5) Avail: NTIS HC A02/MF A01 CSCL 13I

Because many future spacecraft or space stations will require mechanisms to operate for long periods of time in environments which are adverse to most bearing lubricants, a series of tests is continuing to evaluate 38 grease type lubricants in R-4 size bearings in five different environments for a 1 year period. Four repetitions of each test are made to provide statistical samples. These tests were used to select four lubricants for 5 year tests in selected environments with five repetitions of each test for statistical samples. At the present time, 100 test sets are completed and 22 test sets are underway. Three 5 year tests were started in (1) continuous operation and (2) start-stop operation, with both in vacuum at ambient temperatures, and (3) continuous operation at 93.3 C. In the 1 year tests the best results to date in all environments were obtained with a high viscosity index perfluoroalkylpolyether (PFPE) grease. E.D.K.

N81-16476# Oklahoma State Univ., Stillwater. Fluid Power Research Center.
EFFECT ON LUBRICANT CONTAMINANTS OF WEAR RATES OF LUBRICATED COMPONENTS Final Report
R. K. Tessmann, E. C. Fitch, and D. F. Norvelle 13 Nov. 1980 39 p refs
(Contract N68335-76-C-2280; WF53537401)
(AD-A092289; NAEC-92-132) Avail: NTIS HC A03/MF A01 CSCL 11/8

This report presents the results of a study on the effect of particulate contamination upon the wear rates of oil-wetted components normally used in lubrication systems. The components primarily considered were rolling-element bearings, journal bearings, gears, and reciprocating seals. Particulate contaminant parameters are discussed. Component testing methods and systems are presented for each critical wear component category. GRA

N81-16477# Naval Ship Research and Development Center, Bethesda, Md.
FRICTIONAL CHARACTERISTICS OF TILT-PAD AND SWING PAD THRUST BEARINGS
Nathan T. Sides and Thomas L. Daugherty Sep. 1980 47 p refs
(AD-A091909; DTNSRDC-80/101) Avail: NTIS HC A03/MF A01 CSCL 13/10

This report presents frictional performance of oil-lubricated thrust bearings of conventional tilt-pad and swing-pad designs. Results from the conventional tilt-pad bearing are used as a baseline. All tests were conducted at a fixed speed and temperature, while load was varied. All bearings were tested with the pad surfaces in the centered and off-centered positions. Friction results in the hydrodynamic region compared favorably with conventional hydrodynamic theory. The hydrodynamic load capacities of the centered swing-pad bearing designs were 25 to 80 percent higher than that of the centered tilt-pad bearing. Improvements in performance were observed in the regions of hydrodynamic and mixed lubrication by off-setting the pad surfaces for both the tilt-pad and the elastomeric swing-pad designs. Breakaway friction of the laminated elastomeric swing-pad design was about 50 percent higher than that measured for either the conventional tilt-pad or hybrid-pad bearing designs. GRA

N81-16478# Stanford Univ., Calif. Dept. of Computer Science.
OBSTACLE AVOIDANCE AND NAVIGATION IN THE REAL WORLD BY A SEEING ROBOT ROVER
Hans P. Moravec Sep. 1980 92 p refs
(Contract MDA903-80-C-0102; Grant NSF DAR-78-15914)
(AD-A092604; SU-STAN-CS-80-813; AIM-340) Copyright. Avail: NTIS HC A05/MF A01 CSCL 09/2

The Stanford AI Lab cart is a card-table sized mobile robot controlled remotely through a radio link, and equipped with a TV camera and transmitter. A computer was programmed to drive the cart through cluttered indoor and outdoor spaces, gaining its knowledge of the world entirely from images broadcast by

the onboard TV system. The cart uses several kinds of stereo to locate objects around in 3D and to reduce its own motion. It plans an obstacle avoiding path to a desired destination on the basis of a model built with this information. T.M.

N81-16479# TRW, Inc., Cleveland, Ohio. Materials Technology Dept.
ISOTHERMAL FORGING OF LARGE GEARS BY P/M TECHNIQUES Final Report
B. L. Ferguson and D. T. Ostberg May 1980 30 p refs
(Contract DAAK30-78-C-0099)
(AD-A092879; TRW-ER-8057-F; TARADCOM-TR-12521) Avail: NTIS HC A03/MF A01 CSCL 18/8

The development of isothermal forging of steel powder parts to near net shapes with plan areas larger than 100 square inches is reported. The prototype component was the final drive gear of the M60 tank. Based on the finished part dimensions, a forging was developed, a hot die set for isothermal forging was designed, and a segmented preform and compaction tooling were designed. T.M.

N81-16480# Southwest Research Inst., San Antonio, Tex.
METALLURGICAL ANALYSIS OF RIM CRACKING IN AN LP STEAM TURBINE DISC Final Report
H. C. Burghard, Jr. Sep. 1980 185 p refs
(EPRI Proj. 1398-1)
(EPRI-NP-1532) Avail: NTIS HC A09/MF A01

The investigation was based on a metallurgical evaluation of disc rim samples from one of the two rotors involved. The program included a detailed magnetic particle inspection of the rim samples, in-depth metallographic and fractographic examinations of cracked blade attachment steeples and chemical analyses of the disc material. The metallurgical examination identified two characteristics of the cracking; the mode of cracking was predominantly intergranular, and all cracking developed as the results of multiple crack initiation. On the basis of the observations made, it was concluded that the primary mechanism involved was a form of stress corrosion cracking. T.M.

N81-16481# Sandia Labs., Livermore, Calif. Materials Science Div.
MICROSTRUCTURAL CHARACTERIZATION OF AUTOGENOUS GTA WELDS IN A 12Cr-1Mo-0.3v STEEL
J. C. Lippold Oct. 1980 33 p refs Sponsored by DOE
(SAND-80-8236) Avail: NTIS HC A03/MF A01

The weldability of a 12Cr-1Mo-0.3V martensitic stainless steel, a leading candidate for the first wall blanket of fusion reactor, was investigated. Both the continuous cooling transformation diagram and the equilibrium phase diagram were used to rationalize the microstructures observed in the fusion zone and heat affected zone of gas tungsten arc welds. Regions of maximum hardness were observed within the fusion zone and in the coarse grained region of the heat affected zone where the predominant microstructural constituent was untempered martensite. Regions of the heat affected zone which either contained a mixture of untempered martensite and carbides, or were not fully re-austenitized during the weld thermal cycle exhibited a lower as-welded hardness. Residual ferrite in an untempered martensite matrix along the weld fusion line also resulted in a localized drop in hardness. The on-heating and on-cooling transformation behavior of the alloy, as determined with the aid of the Gleeble dilatometer, corroborated both the microstructural observations and the hardness data. A.R.H.

N81-16482# General Electric Co., St. Petersburg, Fla. Metallurgy and Ceramic Lab.
RESISTANCE PROJECTION WELDING OF VACUUM TUBE GETTER ASSEMBLY
F. Kuncz, Jr. 10 Dec. 1980 13 p
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-540) Avail: NTIS HC A02/MF A01

Tungsten inert gas welding the leads to a vacuum tube getter assembly can result in fusion of gettering powder, lowering gas absorption capability. Using resistance projection welding with ball-ended leads, getter bodies were successfully bonded to the leads. Special electrodes were designed. Materials and methods are given for producing ball-ended leads, designating and building special electrodes, and for welding the leads to the body. Author

N81-16483# Los Alamos Scientific Lab., N. Mex.
A LIQUID-HYDROGEN-FUELED BUICK
Walter F. Stewart Nov. 1980 15 p
(LA-8605-MS) Avail: NTIS HC A02/MF A01

A 1979 Buick Century sedan with a displacement turbocharged V-6 engine and automatic transmission was converted to operation on hydrogen supplied to the engine from a liquid hydrogen tank installed in the trunk of the car. The liquid hydrogen tank is refilled using a semiautomatic refueling station designed to be operated by personnel with minimal training. The Buick has a fuel economy corresponding to 8.9 km/l (21 miles/gal.) of gasoline and a range of 274 km (170 miles) in the high altitude area of Los Alamos, New Mexico. Author

N81-16484# General Electric Co., St. Petersburg, Fla. Metallurgy and Ceramic Lab.
PROJECTION WELDING FOR COST CUTTING
F. Kuncz, Jr. 20 Nov. 1980 16 p refs
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-541) Avail: NTIS HC A02/MF A01

Resistance projection welding is described pointing out the advantages, the machine requirements to be met the suitability of various metals and/or metal combinations and the design considerations, the projection design requirements and their placement, and the limitations of this process are discussed. E.D.K.

N81-16485# California Univ., Livermore. Lawrence Livermore Lab.
PREDICTION OF DEFORMATIONS DURING GAS-TUNGSTEN-ARC STATIONARY WELDS
David B. Duncan and Warren H. Giedt (California Univ., Davis) Oct. 1980 25 p refs Presented at ASTM Conf. on Mech. Testing for Deformation Model Develop. Bal Harbour, Fla., 12-13 Nov. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84431) Avail: NTIS HC A02/MF A01

Local temperature measurements on the heated and unheated surfaces, and strain measurements on the unheated surfaces of unrestrained circular weld specimens of annealed and cold-rolled Nitronic 40 stainless steel during stationary welding, are compared with values predicted from finite-element programs for temperature and strain variations. Experimental and predicted temperature histories agree within 10%. Predicted and measured hoop strain profiles (using a moire fringe technique), for the unheated surface are compared, showing significant deviations near the central region. Transient deflection measurements of the unheated specimen surfaces show good agreement with theory during the period the arc is opearating. Close agreement in deflection behavior was observed during the cooling portion of the weld cycle for the annealed specimen, whereas substantial deviations occurred for the cold-rolled specimens. Author

N81-16486# Oak Ridge Y-12 Plant, Tenn. Fabrication Systems Dept.
DIAMOND-TURNING TOOL SETTING BY INTERFEROGRAM ANALYSIS
W. H. Rasnick and R. C. Yoder 22 Oct. 1980 21 p refs
(Contract W-7405-eng-26)
(Y-2198) Avail: NTIS HC A02/MF A01

A method was developed to establish a numerically controlled tool path with respect to the work spindle centerline. Particularly adapted to the diamond turning of optics, this method is based upon interferogram analysis and is applicable to the establishment of the work spindle centerline relative to the tool path for any center-turned optic having a well defined vertex radius of curvature. The application reported is for an f/2 concave spherical mirror. J.M.S.

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N81-16487# California Univ., Livermore. Lawrence Livermore Lab.
MICRORADIOGRAPHY OF ELECTRON BEAM BRAZE JOINS
J. F. Shackelford 24 Jul. 1980 16 p refs
(Contract W-7405-eng-48)
(UCID-18813) Avail: NTIS HC A02/MF A01

Microradiography was used as one phase of a nondestructive evaluation program for inspection of the electron beam braze joining of dissimilar metals. Stainless steel tubing was jointed to a gold-copper disk using a Cusil (copper/silver) brazing alloy. A150-kv X-ray source was used with the radiographs recorded on high-resolution plates. Interpretation of the radiographs was aided by computer graphics displays of digitized film density measurements. Braze intrusion maps were generated indicating the extent of braze penetration into the stainless steel tube. Penetration as small as a few micrometers was observable.
Author

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N81-16488 California Univ., Berkeley.
SMALL DEFORMATIONS SUPERPOSED ON LARGE DEFORMATIONS IN A GENERAL ELASTIC-PLASTIC MATERIAL Ph.D. Thesis
James Casey 1980 130 p
Avail: Univ. Microfilms Order No. 8029346

In the context of a purely mechanical rate-type theory of plasticity and utilizing a strain space formulation, an infinitesimal theory is developed for motions superposed on any given motion of an elastic-plastic material. The given motion may involve all forms of elastic-plastic deformation including both loading and unloading and, in addition, the loading conditions are allowed to change as a result of the superposed motion. The infinitesimal theory is properly invariant under arbitrary finite superposed rigid motions. The strain hardening behavior of finitely deforming elastic-plastic materials is discussed. It is demonstrated that strain-hardening behavior may be characterized by a rate-independent quotient consisting of constitutive functions. The strain response of two sets of special constitutive equations appropriate for small deformation is analyzed. One of these sets of equations is further used to discuss the phenomenon of saturation hardening. Dissert. Abstr.

N81-16489 Texas A&M Univ., College Station.
A MODEL FOR PREDICTING RESPONSE OF NONLINEAR MATERIALS SUBJECTED TO THERMOMECHANICAL LOADING Ph.D. Thesis
David Henry Allen 1980 214 p
Avail: Univ. Microfilms Order No. 8101571

A definition of the thermoelastic plastic creep continuum is given and the phenomena which must be predicted in order to obtain a usable theory for modeling the response of this type of medium is described. Several alternatives are considered for obtaining a complete theoretical solution, and a single method is selected for further study. Dissert. Abstr.

N81-16490 Texas A&M Univ., College Station.
THE EFFECT OF TRANSVERSE SHEAR STRAIN ON LAMINATED CURVED BEAMS Ph.D. Thesis
Wilbur Arthur Hitchcock 1980 109 p
Avail: Univ. Microfilms Order No. 8101603

A theory is developed to take into account the effects of transverse shear strain on the shear stress and circumferential normal stress distributions in homogeneous isotropic or nonhomogeneous laminated curved beams. The theory is based on Kozik's linear exact displacement variations which explicitly show the necessary correction terms which must be added to the classical Kirchhoff displacement variations to take into account the effects of the transverse shear and radial normal strains. An approximate method for determining the shear stress and circumferential normal stress distributions including the effects of transverse shear strain only is presented. The solution scheme is achieved by discretizing the beam into an arbitrary number of layers of equal thickness. A system of differential equations is developed by writing local equilibrium equations at the interfaces between the laminae. The shear stresses at each interface are solved for explicitly and these values are then used to determine the circumferential normal stress distribution. Dissert. Abstr.

N81-16491 Oklahoma Univ., Norman.
THE VIBRATIONAL RESPONSE OF THE RECTANGULAR PARALLELEPIPED Ph.D. Thesis
Eric vonKrumreig Hill 1980 89 p
Avail: Univ. Microfilms Order No. 8101512

This work presents exact normal mode solutions for the forced vibrational response of the rectangular parallelepiped with three sets of boundary conditions: (1) completely rigid lubricated boundaries; (2) two stress free and four rigid lubricated boundaries; and (3) two elastically restrained and four rigid lubricated boundaries. Both analytical and numerical verifications of these solutions are provided. Applications are discussed in the fields of acoustic emission nondestructive testing and the calibration of piezoelectric transducers. Dissert. Abstr.

N81-16492*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL COMPLIANCE CALIBRATION OF THE COMPACT FRACTURE TOUGHNESS SPECIMEN
D. M. Fisher and R. J. Buzzard Dec. 1980 11 p refs
(NASA-TM-81665; E-685) Avail: NTIS HC A02/MF A01 CSCL 20K

Compliances and stress intensity coefficients were determined over crack length to width ratios from 0.1 to 0.8. Displacements were measured at the load points, load line, and crack mouth. Special fixturing was devised to permit accurate measurement of load point displacement. The results are in agreement with the currently used results of boundary collocation analyses. The errors which occur in stress intensity coefficients or specimen energy input determinations made from load line displacement measurements rather than from load point measurements are emphasized.
Author

N81-16493*# Kentron International, Inc., Hampton, Va.
FRANOPP: FRAMEWORK FOR ANALYSIS AND OPTIMIZATION PROBLEMS USER'S GUIDE
Kathleen M. Riley Jan. 1981 75 p refs
(Contract NAS1-16000)
(NASA-CR-165653) Avail: NTIS HC A04/MF A01 CSCL 20K

Framework for analysis and optimization problems (FRANOPP) is a software aid for the study and solution of design (optimization) problems which provides the driving program and plotting capability for a user generated programming system. In addition to FRANOPP, the programming system also contains the optimization code CONMIN, and two user supplied codes, one for analysis and one for output. With FRANOPP the user is provided with five options for studying a design problem. Three of the options utilize the plot capability and present an indepth study of the design problem. The study can be focused on a history of the optimization process or on the interaction of variables within the design problem. E.D.K.

N81-16494*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF MISTUNING ON BENDING-TORSION FLUTTER AND RESPONSE OF A CASCADE IN INCOMPRESSIBLE FLOW
Krishna Rao V. Kaza (Toledo Univ., Ohio) and Robert E. Kielb 1981 20 p refs Proposed for presentation at Dyn. Specialists

Conf., Atlanta, 9-11 Apr. 1981; sponsored by AIAA
(Contract EX-76-I-01-1028)
(NASA-TM-81674; DOE/NASA/1028-29; E-699) Avail: NTIS HC A02/MF A01 CSCL 20K

The effect of small differences between the individual blades (mistuning) on the aeroelastic stability and response of a cascade were studied. The aerodynamic, inertial, and structural coupling between the bending and torsional motions of each blade and the aerodynamic coupling between the blades was considered. A digital computer program was developed to conduct parametric studies. Results indicate that the mistuning has a beneficial effect on the coupled bending torsion and uncoupled torsion flutter. On forced response, however, the effect may be either beneficial or adverse, depending on the engine order of the forcing function. The results also illustrate that it may be feasible to utilize mistuning as a passive control to increase flutter speed while maintaining forced response at an acceptable level. A.R.H.

N81-16495# European Space Agency, Paris (France).
ON THE J-INTEGRAL AND OTHER EVALUATION METHODS OF ELASTIC-PLASTIC FRACTURE MECHANICS AND ON THE LIMITS OF APPLICABILITY OF LINEAR-ELASTIC FRACTURE MECHANICS Ph.D. Thesis - Tech. Hochschule, Aachen
Hans Peter Keller Oct. 1980 156 p refs Transl. into ENGLISH of "Ueber das J-Integral u. andere Auswerteverfahren der Fliessbruchmech. Sowie ueber die Gueltigkeitsgrenzen der linear-elastischen Bruchmech." DFVLR, Cologne Report DFVLR-FB 79-03, Jan. 1979 Original report in GERMAN previously announced as N80-22750
(ESA-TT-617; DFVLR-FB-79-03) Avail: NTIS HC A08/MF A01; Original German report available from DFVLR, Cologne DM 24.90

The critical stress intensity factor for the onset of crack extension was determined by means of linear-elastic fracture mechanics and the various methods of elastic-plastic fracture mechanics, with emphasis on the J-integral method. The specimens used varied in size and were prepared from three steels and two aluminum alloys. The investigations show that linear-elastic fracture mechanics are applicable to specimens far smaller than those stipulated in the standard. The J-integral can be used to determine the critical stress intensity factor for the onset of crack extension for even smaller specimens when crack propagation is ductile, regardless of specimen size. The other methods of elastic-plastic fracture mechanics used were the equivalent energy method and the Eftis and Liebowitz method. Both can also be used to determine the critical stress intensity for ductile crack propagation in small specimens. Author

N81-16496# Naval Research Lab., Washington, D. C. Underwater Sound Reference Detachment.
EFFECTIVE SHEAR MODULUS FOR FLEXURAL AND EXTENSIONAL WAVES IN AN UNLOADED THICK PLATE Interim Report
Pieter S. Dubbelday 29 Sep. 1980 56 p refs
(RR0110842)
(AD-A092149; NRL-8372) Avail: NTIS HC A04/MF A01 CSCL 20/11

Thin-plate theory suffers from failure to properly predict the correct phase speed of bending waves and extensional waves in the limit of high frequency or large thickness. Mindlin has adapted the basic ideas that Timoshenko developed for bars to the case of bending waves in plates to partly correct this situation. Kane and Mindlin have given a similar correction for extensional waves in plates. In this report a new derivation of such correction factors is presented that is based on a comparison of the approximate theory with the results of exact elasticity theory (Lamb waves). Explicit equations are given to compute the effective shear modulus in antisymmetric waves. It is shown analytically that the phase speed calculated with these correction factors for the shear modulus asymptotically approaches the Rayleigh wave speed for high frequency. The same principle of comparison of approximate theory with exact elasticity theory is applied to the other terms in the equations of motion besides those depending on the shear modulus. This has not been entirely successful, but it promises, among other things, to improve the identification of the second root in the quadratic dispersion relation with the first order antisymmetric and symmetric Lamb waves. GRA

N81-16497# Swanson Service Corp., Huntington Beach, Calif.
EVALUATION OF THE NASTRAN GENERAL PURPOSE COMPUTER PROGRAM Final Report
J. W. Jones, H. H. Fong, and D. A. Blehm Aug. 1980 137 p refs
(Contract N00014-79-C-0576)
(AD-A092210; SSC-81980) Avail: NTIS HC A07/MF A01 CSCL 13/13

NASTRAN is a large, general purpose, finite element computer program used primarily for linear structural analysis. In its ten years of existence, NASTRAN has achieved the distinction of being the program with the most users worldwide, most documentation, most user conferences, most cited, and probably the most expensive to develop. The four objectives of this study were to: (1) assess the current status (usage, documentation, trends) of public-domain versions of NASTRAN; (2) evaluate its program architecture, and compare it with some other general purpose codes; (3) survey its functional description, and comment on its capabilities/limitations and such items as matrix operations, eigenvalue extraction schemes, element library, material properties, etc; and (4) perform advanced evaluation exercises on some selected structural elements, and test their convergence, completeness, and efficiency. GRA

N81-16498# Oklahoma Univ., Norman. School of Aerospace Mechanical and Nuclear Engineering.
VIBRATION OF CYLINDRICAL SHELLS OF BIMODULUS COMPOSITE MATERIALS
Charles W. Bert and M. Kumar Oct. 1980 32 p refs
(Contract N00014-78-C-0647)
(AD-A092197; OU-AMNE-80-20; TR-19) Avail: NTIS HC A03/MF A01 CSCL 11/4

A theory is formulated for the small-amplitude free vibration of thick, circular cylindrical shells laminated of bimodulus composite materials, which have different elastic properties depending upon whether the fiber-direction strain is tensile or compressive. The theory used is the dynamic, shear deformable (moderately thick shell) analog of the Sanders best first approximation thin-shell theory. By means of tracers, the analysis can be reduced to various simpler shell theories, namely Love's first approximation and Donnell's shallow-shell theory. As an example of the application of the theory, a closed-form solution is presented for a freely supported panel or complete shell. To validate the analysis, numerical results are compared with existing results for various special cases. Also, the effect of the various shell theories, thickness shear flexibility and bimodulus action are investigated. GRA

N81-16499# Brown Univ., Providence, R. I. Div. of Engineering.
THE EFFECT OF CRACK TRIP PLASTICITY ON THE DETERMINATION OF DYNAMIC STRESS INTENSITY FACTORS BY THE OPTICAL METHOD OF CAUSTICS Interim Report
A. J. Rosakis and L. B. Freund Sep. 1980 46 p refs
(Contract N00014-78-C-0051)
(AD-A092074; N00014-0051/5) Avail: NTIS HC A03/MF A01 CSCL 20/11

The shadow spots which are obtained in using the optical method of caustics to experimentally determine dynamic stress intensity factors are usually interpreted on the basis of a static elastic crack model. In this paper, an attempt is made to include both crack tip plasticity and inertial effects in the analysis underlying the use of the method in reflection. For dynamic crack propagation in the two-dimensional tensile mode which is accompanied by a Dugdale-Barenblatt line plastic zone, the predicted caustic curves and corresponding initial curves are studied within the framework of plane stress and small scale yielding conditions. These curves are found to have geometrical features which are quite different from those for purely elastic crack growth. Estimates are made of the range of system parameters for which plasticity and inertia effects should be included in data analysis when using the method of caustics. For example, it is found that the error introduced through the neglect of plasticity effects in the analysis of data will be small as long as the distance from the crack tip to the initial curve ahead of the tip is more than about twice the plastic zone size. Also, it is found that the error introduced through the neglect

of inertial effects will be small as long as the crack speed is less than about 20% of the longitudinal wave speed. GRA

N81-16500# California Univ., Los Angeles. School of Engineering and Applied Science.

COMPARISON OF THE BEST KNOWN FRACTURE CRITERIA WITH DATA ON NATURALLY OCCURRING CRACKS Interim Report

S. B. Batdorf Jul. 1980 14 p refs Presented at the Intern. Symp. on Absorbed Specific Energy and/or Strain Energy Density, Budapest, 17-19 Sep. 1980

(Contract N00014-76-C-0445)

(AD-A092480; UCLA-ENG-8040) Avail: NTIS HC A02/MF A01 CSCL 20/11

Statistical fracture theory can be used to predict the statistics of fracture for equibiaxial tension when the statistics of fracture are known for simple tension. The result depends on the fracture criterion employed. It is shown that energy density theory (and therefore also specific energy theory) lead to better agreement with the experiment than any other well-known fracture criterion. GRA

N81-16501# Naval Ship Research and Development Center, Bethesda, Md.

RESPONSE OF A POINT EXCITED INFINITELY LONG CYLINDRICAL SHELL IMMERSED IN AN ACOUSTIC MEDIUM

William Vogel and David Felt Nov. 1980 60 p refs

(SF43452702; ZR0110801)

(AD-A091947; DTNSRDC-80/061) Avail: NTIS HC A04/MF A01 CSCL 20/11

The velocity distribution of a point excited, infinitely long, thin cylindrical shell immersed in an acoustic medium is considered. The problem is analyzed by applying integral transform techniques; a solution is then obtained by evaluating the inverse transform integrals numerically. Examples are presented to illustrate the effect of fluid loading on the vibrational behavior of a point excited cylindrical shell. In addition, results are compared with those of a point excited plate with and without fluid loading. GRA

N81-16502# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

FATIGUE IN GRAPHITE/EPOXY BOLTED JOINTS M.S. Thesis

Mark Charles Lee Jun. 1980 69 p refs

(AD-A092362; AFIT-CI-80-14T) Avail: NTIS HC A04/MF A01 CSCL 13/5

Fatigue tests were made on graphite/epoxy bolted joints with an eight ply quasi-isotropic (90 deg, -45 deg, 0 deg, -45 deg)s laminate containing 6.35 mm diameter holes. A tensile load was applied to the specimens using a double lap joint configuration with socket head cap screws torqued to 4.0 N-m. Preliminary investigation involved static testing on a range of specimen geometries to determine failure modes, ultimate strengths, and torque effects. Increasing load (Prot) fatigue tests gave endurance limits as fractions of average static strength and were .94 for tension through the hole, .90 for corner shear/shear, and .88 for bearing. The only comparable existing data found was approximately .80 for bearing fatigue. GRA

N81-16503# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.

BOUNDARY LAYER PHENOMENA IN THE PLASTIC ZONE NEAR A RAPIDLY PROPAGATING CRACK TIP Interim Technical Report

V. Dunayevsky and J. D. Achenbach Oct. 1980 24 p refs

(Contract N00014-76-C-0063)

(AD-A092811; NU-SML-TR-80-2) Avail: NTIS HC A02/MF A01 CSCL 20/11

The steady-state dynamic fields near a rapidly propagating crack tip in an elastic perfectly-plastic material have been investigated for the case of Mode-3 fracture. For arbitrary values of the dimensionless crack-tip speed (M) the inner solution consists of a central-fan field ahead of the crack tip and a uniform field in its wake. It is shown that the inner solution is valid in a 'boundary layer' which shrinks on the crack tip in the limit of vanishing M. For small M the outer solution was found as a regular perturbation expansion in M, with the quasi-static solution as its first term. A uniform expansion over the polar angle omega measured from the plane of the crack was also obtained; its first term displays the connection between the inner and outer solutions. GRA

N81-16504# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Metals and Ceramics Div.

DYNAMIC TENSILE TESTING OF STRUCTURAL MATERIALS USING A SPLIT HOPKINSON BAR APPARATUS Interim Report, Jan. 1973 - Dec. 1979

Theodore Nicholas Oct. 1980 55 p refs

(AF Proj. 2307)

(AD-A092832; AFWAL-TR-80-4053) Avail: NTIS HC A04/MF A01 CSCL 20/11

Stress-strain curves in tension obtained on a large number of structural materials at strain rates up to 1000/s are presented. A modified split Hopkinson bar apparatus used for high strain rate tensile testing is described. Data are compared with other published results. The flow stress of all the materials tested is seen to increase to some extent over the range in strain rates from 0.001 to 1000/s. GRA

N81-16505# Rochester Univ., N. Y.

THE MATERIALS AND MECHANICS OF RATE EFFECTS IN BRITTLE FRACTURE Technical Progress Report, 1979 - Oct. 1980

S. J. Burns 1980 16 p refs

(Contract DE-AS02-76ER-02422)

(COO-2422-28) Avail: NTIS HC A02/MF A01

Energy balance methods were used to find the crack driving force in elastic fractures. The fracture toughness of cracked steel bars was measured using these techniques. Crack tip dislocations were shown to protect the crack tip by having a stress intensity value that is opposite in sign from the applied stress intensity value. Thus, crack tip dislocation plasticity shields the crack from the external stress intensity factor. In the fatigue of LiF single crystals a relationship between monotonic and fatigue hardening responses was established using a statistical model for fatigue deformation. Author

N81-16506# Sandia Labs., Albuquerque, N. Mex. Nondestructive Testing Technology Div.

ULTRASONIC SHEAR WAVE VELOCITY IN CLF/CMT GRAPHITE FROM ROOM TEMPERATURE TO 2000 DEG F

John H. Gieske Nov. 1980 36 p refs Sponsored by DOE

(SAND-80-1850) Avail: NTIS HC A03/MF A01

The temperature dependence of the ultrasonic shear velocity in CLF/CMT graphite was determined from room temperature to 2000 F using a pulse echo technique. Data are presented for five 0.75 inch diameter specimens all machined from the same CLF/CMT billet. Plots of ultrasonic pulse echo radial and axial scans of the billet which characterize the material property uniformity of the billet are also given. Author

N81-16507# California Univ., Livermore. Lawrence Livermore Lab.

COMPUTER SIMULATION OF FRACTURE TESTS

Mark L. Wilkins and J. E. Reaugh (Science Applications, Inc., San Leandro, Calif.) 26 Sep. 1980 17 p refs Presented at Intern. Symp. on Defects and Fracture, Tuczno, Poland, Oct. 1980 Sponsored in part by EPRI

(Contract W-7405-eng-48)

(UCRL-84793; CONF-801070-1) Avail: NTIS HC A02/MF A01

Two and three dimensional finite-difference computer programs are used to simulate the initiation and propagation of cracks in a ductile material. A cumulative strain damage model describes the history of damage to the material from external forces. The programs use incremental plasticity theory to describe large plastic strains with rotation. The fracture model assumes that a crack will initiate and propagate when damage exceeds a critical value over a critical distance. Applications to engineering fracture toughness tests of 6051-T651 aluminum are presented. Author

N81-16508# Sandia Labs., Albuquerque, N. Mex.

DEFORMATION MODELING AND THE STRAIN TRANSIENT

DIP TEST
Wendell B. Jones, R. W. Rohde, and J. G. Swearengen 1980 35 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-1264C; CONF-801148-2) Avail: NTIS HC A03/MF A01

The strain transient dip test is simple in concept, but is extremely difficult to perform in actuality. The critical measurement in this test is the absence of a resolvable creep rate after a stress drop. As a consequence, the result is extraordinarily sensitive to strain resolution as well as machine mechanical response. The design of a machine in which these spurious effects are minimized is presented and the nature of the strain transient dip test is discussed using the example of aluminum. It is concluded that the strain transient dip test is not useful as the primary test for verifying any micromechanical model of deformation. If a model can be developed that is verifiable by other experiments, data from a dip test machine may be used to generate model parameters. A.R.H.

N81-16509# Westinghouse Electric Corp., Madison, Pa. Advanced Reactor Div.
PLASTIC IN-PLANE BENDING AND BUCKLING ANALYSIS OF AN ELBOW TESTED AT 1100 DEG F
L. H. Sobel, S. Z. Newman, and E. C. Bishop Jun. 1980 81 p refs
(Contracts DE-AM02-76CH-94009; DE-AT02-80CH-94049)
(WARD-HT-94000-8) Avail: NTIS HC A05/MF A01

Predictions obtained from a simplified finite element analysis are compared with experimental results for the plastic in-plane bending and buckling of a 16 in diameter type 304 stainless steel piping structure, which consists of a 90 deg elbow and two straight tangent pipes, and which was tested at 1100 F (593 C). The large displacement analysis is based on the widely used MARC pipe-bend element 17, and on a stress strain curve obtained from coupon specimens taken from the elbow after it was tested to buckling. The analysis is found to underestimate the experimental buckling load by 28% and to considerably overestimate the deformation at each load level. Reasons are given which account for a part of these unexpectedly large discrepancies. The Southwell method is applied to the test results and is shown to provide an accurate estimate of the experimental buckling load provided that the nonlinear component of the deformation is used in the Southwell plot. Author

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

N81-16510 Michigan State Univ., East Lansing.
THE INDIAN LANDS STUDY: AN EXAMPLE OF THE APPLICATION OF GEOGRAPHIC RESEARCH TO THE ANALYSIS OF COMPLEX ENERGY AND ENVIRONMENTAL POLICY ISSUES Ph.D. Thesis
Douglas Burton Richardson 1980 397 p
Avail: Univ. Microfilms Order No. 8101157

Numerous policy and land use planning issues related to controlling the environmental impacts and changes which accompany large scale surface mining on Indian lands were analyzed. The spatial area encompassed by the project includes all twenty-five Indian reservation in the United States which are known to contain coal resources. The subject matter of the study ranged from the physical landscapes of those areas to their political and cultural environments to their interaction with the larger, national region in two key areas--the quest for an expanded energy supply, and the need to prevent environmental damage and degradation. The Study's final report, entitled The Control and Reclamation of Surface Mining on Indian Lands, brings together a comprehensive set of data on the contemporary North American Indian setting, and in so doing addresses an important range of the key energy related issues confronting tribes in their modern environment. Dissert. Abstr.

N81-16511 State Univ. of New York at Binghamton.
AUTOMATED CLASSIFICATION OF AERIAL PHOTOGRAPHIES Ph.D. Thesis
Timothy David Masters 1980 170 p
Avail: Univ. Microfilms Order No. 8100295

Three aspects of the automated interpretation of aerial photographs are considered. First is the selection and computation of variables suitable for the identification of unique training areas. Both black and white and four band multispectral frames are considered. Measures of tone, texture and special purpose variables are studied. Particular attention is paid to speed of computation and generalizability. Second, algorithms which greatly speed the selection of training sets are presented. These include automatic splitting of multimodal sets, rejection of outliers and selection of training sets without the need for supervision. Third, discrimination algorithm is presented. The algorithm is not distribution-free but is far more rugged than the normal maximum likelihood method against the high skewed distributions frequently encountered in the analysis of aerial photographs. A fourth section demonstrates these algorithms using two black and white and two color frames. Dissert. Abstr.

N81-16512*# Research Triangle Inst., Research Triangle Park, N. C.
CONCEPTS FOR ON-BOARD SATELLITE IMAGE REGISTRATION, VOLUME 1
W. H. Ruedger, D. R. Daluge, and J. V. Aanstoos Jun. 1980 155 p refs
(Contract NAS1-15768)
(NASA-CR-159287; RTI/1796/00-01F-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 05B

The NASA-NEEDS program goals present a requirement for on-board signal processing to achieve user-compatible, information-adaptive data acquisition. One very specific area of interest is the preprocessing required to register imaging sensor data which have been distorted by anomalies in subsatellite-point position and/or attitude control. The concepts and considerations involved in using state-of-the-art positioning systems such as the Global Positioning System (GPS) in concert with state-of-the-art attitude stabilization and/or determination systems to provide the required registration accuracy are discussed with emphasis on assessing the accuracy to which a given image picture element can be located and identified, determining those algorithms required to augment the registration procedure and evaluating the technology impact on performing these procedures on-board the satellite. A.R.H.

N81-16513*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REGIONAL PRICE TARGETS APPROPRIATE FOR ADVANCED COAL EXTRACTION
Katsuaki L. Terasawa and David M. Whipple 1 Dec. 1980 74 p refs
(Contracts NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-163896; JPL-Pub-80-91) Avail: NTIS HC A04/MF A01 CSCL 08I

A methodology is presented for predicting coal prices in regional markets for the target time frames 1985 and 2000 that could subsequently be used to guide the development of an advanced coal extraction system. The model constructed is a supply and demand model that focuses on underground mining since the advanced technology is expected to be developed for these reserves by the target years. Coal reserve data and the cost of operating a mine are used to obtain the minimum acceptable selling price that would induce the producer to bring the mine into production. Based on this information, market supply curves can be generated. Demand by region is calculated based on an EEA methodology that emphasizes demand by electric

utilities and demand by industry. The demand and supply curves are then used to obtain the price targets. The results show a growth in the size of the markets for compliance and low sulphur coal regions. A significant rise in the real price of coal is not expected even by the year 2000. The model predicts heavy reliance on mines with thick seams, larger block size and deep overburden. A.R.H.

N81-16514*# Environmental Research and Technology, Inc., Concord, Mass.

ANALYSIS OF GOES IMAGERY AND DIGITIZED DATA FOR THE SEV-UPS PERIOD, AUGUST 1979 Final Report

Clinton J. Bowley, Hsiao-Hua K. Burke, and James C. Barnes Feb. 1981 35 p refs

(Contract NAS1-16108)

(NASA-CR-165656; A-533F) Avail: NTIS HC A03/MF A01 CSCL 05B

In support of the Southeastern Virginia Urban Plume Study (SEV-UPS), GOES satellite imagery was analyzed for the month of August 1979. The analyzed GOES images provide an additional source of meteorological input useful in the evaluation of air quality data collected during the month long period of the SEV-UPS experiment. In addition to the imagery analysis, GOES digitized data were analyzed for the period of August 6 to 11, during which a regional haze pattern was detectable in the imagery. The results of the study indicate that the observed haze patterns correspond closely with areas shown in surface based measurements to have reduced visibilities and elevated pollution levels. Moreover, the results of the analysis of digitized data indicate that digital reflectance counts can be directly related to haze intensity both over land and ocean. The model results agree closely with the observed GOES digital reflectance counts, providing further indication that satellite remote sensing can be a useful tool for monitoring regional elevated pollution episodes. Author

N81-16515*# Ocean Weather, Inc., White Plains, N.Y.

SIMULATION STUDIES OF THE APPLICATION OF SEASAT DATA IN WEATHER AND STATE OF SEA FORECASTING MODELS Final Report

Vincent J. Cardone and J. Arthur Greenwood Oct. 1979 94 p refs

(Contract NAS5-24498)

(NASA-CR-160085) Avail: NTIS HC A05/MF A01 CSCL 05B

The design and analysis of SEASAT simulation studies in which the error structure of conventional analyses and forecasts is modeled realistically are presented. The development and computer implementation of a global spectral ocean wave model is described. The design of algorithms for the assimilation of theoretical wind data into computers and for the utilization of real wind data and wave height data in a coupled computer system are presented. T.M.

N81-16516# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

INVESTIGATIONS OF SEA ICE ANISOTROPY, ELECTROMAGNETIC PROPERTIES, STRENGTH, AND UNDER-ICE CURRENT ORIENTATION

Austin Kovacs and Rexford M. Morey Sep. 1980 27 p refs (NR Proj. 307-393)

(AD-A092089; CRREL-80-20) Avail: NTIS HC A03/MF A01 CSCL 08/12

Results of impulse radar studies of sea ice give support to the concept of a sea ice model in which the ice bottom is composed of an array of lossy parallel plate waveguides. The fundamental relation between the average bulk brine volume of sea ice and its electrical and strength properties is discussed as is the remote detection of under-ice current alignment. It was found that (1) the average effective bulk dielectric constant is dependent upon the average bulk brine volume of the sea ice; (2) sea ice anisotropy, arising from a bottom structure of crystal platelets with a preferred c-axis horizontal alignment, can be detected by radio echo sounding measurements made not only on the ice surface but also from an airborne platform; (3) the effective coefficient of reflection from the sea ice bottom decreases with increasing average effective bulk dielectric constant of the ice, decreases with increasing bulk brine volume, and is typically one to two orders of magnitude lower than the coefficient of reflection from the ice surface; and (4) the losses in sea ice increase with increasing average bulk brine volume. GRA

N81-16517# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.

SIMPLE ALGORITHMS FOR CALCULATION OF SCALE FACTORS FOR PLAN COORDINATE SYSTEMS (1927 NAD AND 1983 NAD)

Herbert W. Stoughton Oct. 1980 25 p refs

(AD-A092461) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper presents a hand-held calculator algorithm to compute scale factors for state plane coordinate systems. A second algorithm is presented for digital computers. The algorithms are applicable to any figure of the Earth, but this paper addresses Clarke 1866 (NAD 1927) and NAD 1983. GRA

N81-16518# Naval Postgraduate School, Monterey, Calif. Dept. of Oceanography.

SUBSURFACE DYNAMICAL PROPERTIES OF VARIABLE FEATURES SEEN IN SATELLITE IR IMAGERY OFF POINT SUR AND THEIR ACOUSTIC SIGNIFICANCE M.S. Thesis

John Edward Johnson, Jr. Jun. 1980 240 p refs

(AD-A092632) Avail: NTIS HC A11/MF A01 CSCL 08/10

This study is a continuation of chemical mesoscale research of cold water anomalies detected by satellite IR imagery off the Point Sur area with emphasis upon description of the thermal structure. Analysis of dynamic forcing is restricted to the relationship between equatorward alongshore wind stress and coastal upwelling. The preferred location of the features was on the south side of Point Sur near the axis of a mesoscale canyon (consistent with background theory). In all cases, a surface (upper 100 m) 'lens' type feature with horizontal dimensions of 20 km at 50 m was observed below the surface cold spot expression. Typical temperature changes across the feature were of the order of 3 C/10 km with temperature changes across frontal zones of the order of 1 C/km. The surface density field pattern of November 1979 was similar to the surface temperature pattern. As determined by Parabolic Equation (PE) Acosutic Model runs, the presence of the wedge decreased propagation loss particularly in the cross shelf directions. GRA

N81-16519# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Environmental Lab.

ACQUISITION OF TERRAIN INFORMATION USING LANDSAT MULTISPECTRAL DATA. REPORT 3: APPLICATION OF AN INTERACTIVE CLASSIFICATION PROCEDURE IN SOUTH LOUISIANA

Margaret H. Smith and Horton Struve Sep. 1980 125 p refs (DA Proj. 4A1-61101-A-91D)

(AD-A092807; WES-TR-M-77-2-3-Pt-3) Avail: NTIS HC A06/MF A01 CSCL 08/6

This report documents the application of an interactive Landsat classification procedure in South Louisiana. The procedure, discussed in Report 2 of this series, is an interim solution to the problem of mapping very large areas in terms of relatively crude categories in very short periods of time. The area selected for study was Baton Rouge and vicinity. This area includes a portion of the Mississippi River, wooded areas, farm land, and various categories of urban land use. The procedure successfully classified the water, woods, farm land, and industrialized urban categories, but failed to correctly classify residential urban areas due to the nonuniqueness of their spectral signatures. GRA

N81-16520# Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

MAP OF MIXED PRAIRIE GRASSLAND VEGETATION, ROCKY FLATS, COLORADO

S. J. V. Clark, P. J. Webber, and V. Komarkova 1980 90 p refs

(Contract E(11-1)-2371)

(DOE/EV-02371/T1; INSTAAR/OP-35; ISSN-0069-6145) Avail: NTIS HC A05/MF A01

A color vegetation map at the scale of 1:12,000 of the area surrounding the Rocky Flats, Rockwell International Plant near Boulder, Colorado, provides a permanent record of baseline data which can be used to monitor changes in both vegetation and environment and thus to contribute to future land management

and land use policies. A modified Bray and Curtis ordination was used to determine the environmental factor complexes controlling the distribution of vegetation at Rocky Flats. Three environmental factor complexes correlated significantly with the ordination axes: percentage of nonvegetated area (X axis), moisture regime (Y axis), and grazing regime (Z axis). This correlation agreed well with the observations made during field work and during map analysis. The growth forms were shown to have a significant relationship with the controlling environmental factors. Recommendations are made for future policies of environmental management and predictions of the response to environmental change of the present vegetation at the Rocky Flats site. E.D.K.

N81-16521# Washington Univ., Seattle. Dept. of Oceanography.
THE USE OF SEASAT (SMMR) IMAGERY TO STUDY THE BERING SEA ICE Interim Report
Seelye Martin 1 Jul. 1980 22 p refs
(Contract MO-A01-78-00-4335)
(PB81-106643; REF-A80-21; NOAA-80090806) Avail: NTIS HC A02/MF A01 CSCL 08L

The movement of thick ice by winds and currents represents a potential hazard to any future drilling operations in lease areas such as the Navarin Basin and Bristol Bay. The knowledge of the ice edge properties and ability to forecast the edge position is essential to the safety of fishing boats operating near the edge. It was observed that the ice divided into three general types moving in from the pack edge. The cause of these three different zones appears to be the ocean swell. This means that when the wind blows from the north, the increased surface roughness causes greater atmospheric drag and the roughened ice is blown away from the pack where it forms the observed ice bands. GRA

N81-16522# Texas A&M Univ., College Station.
HEAT TRANSPORT IN GROUNDWATER SYSTEMS. VOLUME 1: FINITE ELEMENT MODEL Progress Report, 1 Jul. 1976 - 31 Dec. 1978
Elston Kent Grubaugh and Donald L. Reddell Aug. 1980 189 p refs 2 Vol.
(Contracts DI-14-34-0001-7091; DI-14-34-0001-7092; DI-14-34-0001-8046)
(PB81-104127; TR-104-Vol-1; W80-06699-Vol-1; OWRT-A-039-TEX(1)-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 08H

A numerical simulation model was developed to predict the response of a multiple groundwater aquifer to the operation and of injection and pumping wells system transporting hot water (heated by solar collectors) for long-term aquifer storage of solar energy. The development of numerical models to evaluate the nonsteady, areal, hydrostatic pressure distribution and water movement is described. The non-steady, areal, heat transfer and temperature distribution, in a multiple aquifer groundwater system are detailed. The developed models were combined into a numerical simulation that would predict water temperature and pressure throughout the aquifer system when hot/cold pumping and injection wells are operated. GRA

N81-16523# Texas A&M Univ., College Station.
HEAT TRANSPORT IN GROUNDWATER SYSTEMS. VOLUME 2: LABORATORY MODEL Progress Report, 1 Jul. 1976 - 31 Dec. 1978
David Bryan Reed and Donald L. Reddell Aug. 1980 168 p refs 2 Vol.
(Contracts DI-14-34-0001-7091; DI-14-34-0001-7092; DI-14-34-0001-8046)
(PB81-104135; TR-104-Vol-2; W80-06700-Vol-2; OWRT-A-039-TEX(2)-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 08H

A laboratory model tank (1.8288 in deep, 0.2 radian sector, with 7.01 m in the radial direction) was constructed to simulate injection of hot water (heated from solar collectors) into a confined aquifer. Temperature and pressure were taken to monitor the hot water front as it moved through the model. Temperatures were measured at 6 different radial distances from the well and 7 vertical heights above the bottom of the flow layer. Four runs were made with water supplied to the tank at constant temperature and flow rate, one in which no heat transfer occurred and hydraulic conductivity was measured, three in which heat transfer was monitored. For the latter runs, hydraulic conductivity increased as aquifer temperature increased. Injection rates were only indirectly related to thermal efficiency. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N81-16524# Committee on Science and Technology (U. S. House).
NATIONAL ACADEMY OF SCIENCES REPORT: ENERGY IN TRANSITION, 1985-2010
Washington GPO 1980 150 p refs Hearing before the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 119, 25 Jan. 1980
(GPO-61-647) Avail: Committee on Science and Technology

The results of the report of the Committee on Nuclear and Alternative Energy Systems, known as the CONAES report, were reviewed. The economic, social and technical aspects of energy policy options during the remainder of the 20th century and early in the 21st century were examined. The results are used as one of many guidelines in energy policy making. T.M.

N81-16525# Committee of Conference (U. S. Congress).
WIND ENERGY SYSTEMS ACT OF 1980
Washington GPO 1980 17 p Conf. Rept. to accompany H. R. 5892 presented by the Comm. of Conf. at the 96th Congr., 2nd Sess., 1 Aug. 1980
(H-Rept-96-1217) Avail: US Capitol, House Document Room

A compromise set of findings and purpose was adopted which is based on parts of both the House and Senate bills. By the end of 1988, the Act seeks (1) to reduce the average cost of electricity produced by installed wind energy systems; (2) to reach a total megawatt capacity in the U.S. from wind energy systems of at least 800 megawatts, of which at least 100 megawatts are provided by small wind energy systems; and (3) to accelerate the growth of a commercially viable and competitive industry to make wind energy systems available to the general public as an option. It is recommended that the House recede from disagreement to the Senate amendment to test the bill and agree on a compromise title. A.R.H.

N81-16526# Committee on Science and Technology (U. S. House).
FORESIGHT. VOLUME 1: SOCIETAL ASPECTS OF HYDROGEN ENERGY SYSTEMS
Washington GPO 1979 167 p refs Presented to the Subcomm. on Advan. Energy Technol. and Energy Conservation Res. Develop. and Demonstration of the Comm. on Sci. and Technol., 95th Congr., 2nd Sess., December 1978 Prepared by Science Policy Research Div., Library of Congress and NBS, Washington, D.C.
(GPO-47-018) Avail: SOD

A workshop to outline the important societal aspects of hydrogen energy systems was arranged by the National Bureau of Standards at the request of a Congressional Committee. The objectives were (1) to study the conditions under which hydrogen can emerge as a major fuel of the future; (2) to identify barriers and incentives to implementation; (3) to make comparisons with alternate fuels; and (4) to outline policy changes which would speed hydrogen use. Seventy invited participants along with input from six parallel interdisciplinary groups provided the basis for a response to Congress. An overview of forecasting methodologies is included and the space program is used as a case study of retrospective forecasting. A.R.H.

N81-16527# Committee on Science and Technology (U. S. House).
FORESIGHT. VOLUME 2: ENERGY CONSERVATION IN CITIES
Washington GPO 1979 123 p refs Presented to the Subcomm. on Advan. Energy Technol. and Energy Conserv. Res., Develop. and Demonstration of the Comm. on Sci and Technol., 95th Congr., 2nd Sess., Dec. 1978 Prepared by Congressional Research Service, Library of Congress
(GPO-47-454) Avail: SOD

A review of the development of cities is presented along with demographic patterns and imperatives that affect energy conservation. Public reactions to energy conservation were surveyed and planning strategies and policies were developed. Social and institutional barriers to energy conservation were examined. Problems that cities have with federal energy conservation programs were reviewed. Urban planning with emphasis on energy conservation was discussed. T.M.

N81-16528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH VOLTAGE PLANAR MULTIJUNCTION Patent Application
J. C. Evans, Jr., A. T. Chai, inventors (to NASA), and C. P. Goradia Filed 24 Dec. 1980 15 p
(NASA-Case-LEW-13400-1; US-Patent-Appl-SN-219677) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar cell which provides high output voltages, comprises a semiconductor wafer in which a number or array of voltage generating regions or unit cells are formed. Each of the unit cells has two regions of opposite conductivity type (e.g., n+ and p+) which are separated by a gap region. The unit cells are connected together by metal contacts so that their outputs are additive. Field regions, separated by gaps, overlie the unit cells. Cells are formed in both faces of the wafer; a circular wafer is employed. NASA

N81-16529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH VOLTAGE V-GROOVE SOLAR CELL Patent Application
John C. Evans, Jr., An-Ti Chai, and Chandra P. Goradia Filed 24 Dec. 1980 11 p
(NASA-Case-LEW-13401-1; US-Patent-Appl-SN-219678) Avail: NTIS HC A02/MF A01 CSCL 10A

The fabrication of the cell is described. The solar cell features a plurality of discrete voltage generating regions or unit cells which are formed in a single, generally planar semiconductor body. The unit cells comprise doped regions of opposite conductivity type separated by a gap or indiffused regions. Metal contacts connect adjacent cells together in series so that the output voltages of the individual cells are additive. In some embodiments, doped field regions separated by gaps overlie the unit cells but the cells may be formed in both faces of the wafer. T.M.

N81-16530*# National Aeronautics and Space Administration, Washington, D. C.
SOLAR POWER SATELLITE SYSTEM Patent Application
George L. Sarver, III, inventor (to NASA) (MIT, Cambridge) Filed 29 Sep. 1980 11 p Sponsored by NASA
(NASA-Case-HQN-10949-1; US-Patent-Appl-SN-191747) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar power satellite system is provided which includes a power satellite and at least one reflector satellite. The power satellite, which constitutes the great mass of the system, has a geosynchronous, gravity gradient stabilized orbit. The power satellite comprises a planar array of solar cells, with the plane of the satellite being oriented so as to be parallel with the plane of its orbit. An antenna or antennas mounted on the power satellite are powered by the solar cells and serve to transmit microwave energy back to earth. The shape and orbit of the reflector satellite are controlled so that solar radiation is focused by the reflector satellite onto the solar array of the power satellite. NASA

N81-16531# Comptroller General of the United States, Washington, D.C.
A FRAMEWORK FOR DEVELOPING A NATIONAL ENERGY CONSERVATION PROGRAM
31 Jul. 1979 60 p refs
(EMD-79-76) Avail: NTIS HC A04/MF A01

A decision making framework is discussed which is intended as one approach for considering the wide range of alternatives available to the Government for achieving more energy conservation in the Nation. The framework provides for evaluating energy conservation strategies ranging from voluntary initiatives to mandatory actions. It also provides for selecting specific policies and programs based on an evaluation of expected energy savings and costs and on environmental, economic, and social impacts. A.R.H.

N81-16532# Comptroller General of the United States, Washington, D.C.
HOW THE PETROLEUM REFINING INDUSTRY APPROACHES ENERGY CONSERVATION. A CASE STUDY
13 Jun. 1980 70 p refs
(EMD-80-55) Avail: NTIS HC A04/MF A01

The U.S. petroleum refining industry accounts for about 4 percent of total domestic energy consumption and over 10 percent of all energy consumed by the industrial sector. The refining industry has achieved significant improvements in efficiency in the past and expects continued improvements. Conservation achievements are examined and the impact of existing Federal energy conservation programs in furthering conservation gains are assessed. The definition of 'conservation' used includes both increased energy efficiency and fuel substitution. A.R.H.

N81-16533*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR POWER SATELLITE MICROWAVE TRANSMISSION AND RECEPTION
R. H. Dietz Dec. 1980 271 p refs Workshop held in Houston, Tex., 15-18 Jan. 1980
(NASA-CP-2141; S-503) Avail: NTIS HC A16/MF A01 CSCL 10A

Numerous analytical and experimental investigations related to SPS microwave power transmission and reception are reported. Aspects discussed include system performance, phase control, power amplifiers, radiating elements, rectenna, solid state configurations, and planned program activities. For individual titles, see N81-16534 through N81-16568.

N81-16534*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SYSTEM PERFORMANCE CONCLUSIONS
G. D. Arndt *In its* Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 7-17 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The advantages and disadvantages of reducing power levels and using antennas with diameters smaller than 1 Km were evaluated if rectenna costs and land usage requirements become major factors, operating at 5800 megahertz should be considered. Three sequences (random, incoherent phasing, and concentric rings - center to edge) provided satisfactory performance in that the resultant sidelobe levels during startup/ shutdown were lower than the steady-state levels present during normal operations. Grating lobe peaks and scattered power levels were used to determine the array/subarray mechanical alignment requirements. The antenna alignment requirement is 1 min or 3 min depending on phase control configuration. System error parameters were defined to minimize scattered microwave power. A.R.H.

N81-16535*# Boeing Aerospace Co., Seattle, Wash.
SOLAR POWER SATELLITE MICROWAVE POWER TRANSMISSION SYSTEM DESCRIPTION EXECUTIVE SUMMARY
Gordon R. Woodcock *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 18-27 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The history of the concept of microwave power beaming to Earth is reviewed with emphasis on transmission frequency selection. Constraints on the system power level results from (1) required rejection of waste heat resulting from inefficiencies in the cover conversion of dc electric power to microwave power;

(2) the rf power intensity in the ionosphere; and (3) the effect of sidelobe level on aperture illumination factors. Transmitter arrangement, the power distribution system, attitude control, subarrays, waveguides, and alignment are discussed. A.R.H.

N81-16536*# Raytheon Co., Lexington, Mass.
INITIAL MPTS STUDY RESULTS: DESIGN CONSIDERATIONS AND ISSUES
Owen E. Maynard *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 28-32 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

One of the key issues identified during investigations of microwave power transmission systems from 1965 to 1976 was the need to assure that the billions of diodes on ground-based rectennas are sufficiently reliable to support long life times of approximately 30 years. Major systems studies conducted focused on waveguides; radio frequency interference and biological considerations; the relationship between performance, weight, and cost; risk assessment; crossed field directional amplifier noise; a 48 kW klystron; effects of the environment on propagation and phase control; rectenna technology; a rationale for the ground power density region; alternate technologies for orbital assembly; ionospheric effects and phase control; and reception conversion (rf to dc collector/converter). A.R.H.

N81-16537*# Boeing Aerospace Co., Seattle, Wash.
SPS LARGE ARRAY SIMULATION
S. Rathjen, B. R. Sperber, and E. J. Nalos *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 33-42 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Three types of computer simulations were developed to study the SPS microwave power transmission system (MPTS). The radially symmetric array simulation is low cost and is utilized to investigate general overall characteristics of the spacetenna at the array level only. 'Tiltmain', a subarray level simulation program, is used to study the effects of system errors which modify the far-field pattern. The most recently designed program, 'Modmain,' takes the detail of simulation down to the RF module level and so to date is the closest numerical model of the reference design. A.R.H.

N81-16538*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ACHIEVABLE FLATNESS IN A LARGE MICROWAVE POWER TRANSMITTING ANTENNA
R. C. Ried *In its* Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 43-45 ref (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

A dual reference SPS system with pseudoisotropic graphite composite as a representative dimensionally stable composite was studied. The loads, accelerations, thermal environments, temperatures and distortions were calculated for a variety of operational SPS conditions along with statistical considerations of material properties, manufacturing tolerances, measurement accuracy and the resulting loss of sight (LOS) and local slope distributions. A LOS error and a subarray rms slope error of two arc minutes can be achieved with a passive system. Results show that existing materials measurement, manufacturing, assembly and alignment techniques can be used to build the microwave power transmission system antenna structure. Manufacturing tolerance can be critical to rms slope error. The slope error budget can be met with a passive system. Structural joints without free play are essential in the assembly of the large truss structure. Variations in material properties, particularly for coefficient of thermal expansion from part to part, is more significant than actual value. A.R.H.

N81-16539*# Axiomatix, Los Angeles, Calif.
AN ACTIVE ALIGNMENT SCHEME FOR THE MPTS ARRAY
Richard Iwaseki *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 46-62 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

In order to achieve and maintain required flatness of the antenna array, a rotating laser beam used for leveling applications on earth was utilized as a reference system. A photoconductive sensor with a reflective collecting surface determines the displacement and polarity of any misalignment and automatically engages a stepping motor to drive a variable-length mechanism to make the necessary corrections. Once aligned, little power is dissipated since a nulling bridge circuit that centers on the beam is used. A three-point subarray alignment arrangement is described which independently adjusts, in the three orthogonal directions, the height and tilt of subarrays within the MPTS array and readily adapts to any physical distortions of the secondary structure (such as that resulting from severe temperature extremes caused by an eclipse of the Sun). It is shown that only one rotating laser system is required since optical blockage is minimal on the array surface and that it is possible to incorporate a number of redundant laser systems for reliability without affecting the overall performance. A.R.H.

N81-16540*# Emmanuel Coll., Boston, Mass.
PROPOSED EXPERIMENTAL STUDIES FOR ASSESSING IONOSPHERIC PERTURBATIONS ON SPS UPLINKING PILOT BEAM SIGNAL
Santimay Basu and Sunanda Basu *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 63-76 refs (For primary document see N81-16533 07-44)
(Contract F19628-78-C-0005; Grant NSF ATM-78-25264)
Avail: NTIS HC A16/MF A01 CSCL 10A

Evidence is presented for the occurrence of natural irregularities at midlatitude based on scintillation measurements by the use of VHF and GHz transmission from geostationary satellites, and from satellite in-situ measurements. An effort to determine the phase and intensity scintillation effects during ionospheric heating is described along with proposed measurements related to the detection, lifetimes, and drift of artificial irregularities generated by ionospheric heating in the underdense mode. A.R.H.

N81-16541*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ACTIVE RETRODIRECTIVE ARRAYS FOR SPS BEAM POINTING
Ralph Chernoff *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 79-101 ref (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The basic requirement of the SPS beam pointing system is that it deliver a certain amount of S-band (lambda = 12.5 cm) power to a 9.6 km diameter receiving rectenna on the ground. The power is transmitted from a 1.0 km diameter antenna array on the SPS, which is, for a rectenna at about plus or minus 40 deg. latitude, some 37.5x10 to the 6th power km distant. At the present time ARA's appear to be the best bet to realize this very stringent beam pointing requirement. An active retrodirective array (ARA) transmits a beam towards the apparent source of an illuminating signal called the pilot. The array produces, not merely reflects, RF power. Retrodirectivity is achieved by retransmitting from each element of the array a signal whose phase is the 'conjugate' of that received by the element. Phase conjugate circuits and pointing errors in ARA's are described. Results obtained using a 2-element X-band ARA and an 8-element S-band ARA are included. A.R.H.

N81-16542*# LinCom Corp., Los Angeles, Calif.
PERFORMANCE ANALYSIS AND SIMULATION OF THE SPS REFERENCE PHASE CONTROL SYSTEM
W. C. Lindsey and C. M. Chie *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 102-118 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The major elements required in the operation of an SPS which employs retrodirectivity as a means of pointing the beam to Earth include the spacetenna, the rectenna, and the pilot signal transmitter. The phase control system is faced with several problems: (1) path delay variations due to imperfect SPS circular orbits; (2) ionospheric effects; (3) initial phase beam forming;

(4) beam pointing; (5) beam safing; (6) high power phase noise effects; and (7) interference. The use of SOLARISM, a computer program to select pilot signal parameters and evaluate SPS performance is described. A.R.H.

N81-16543*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
DESIGN AND BREADBOARD EVALUATION OF THE SPS REFERENCE PHASE CONTROL SYSTEM CONCEPT
P. M. Hopkins and V. R. Rao *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 119-128 refs (For primary document see N81-16533 07-44)
(Contract NAS9-15800)
Avail: NTIS HC A16/MF A01 CSCL 10A

The total breadboard system includes one pilot transmitter, one pilot receiver, nine phase distribution units, and two power transponders. With this complement of equipment, segments of a typical phase distribution system can be assembled to facilitate the evaluation of significant system parameters. The achievable accuracy of a large phase distribution system, the sensitivity of the system to parameter variations, and the limitations of commercially available components in such applications were determined. T.M.

N81-16544*# LinCom Corp., Los Angeles, Calif.
COHERENT MULTIPLE TONE TECHNIQUE FOR GROUND BASED SPS CONTROL
C. M. Chie *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1981 p 129-138 refs (For primary document see N81-16533 07-44)
(Contract NAS9-15782)
Avail: NTIS HC A16/MF A01

The control system achieves beam forming by adjusting the phases of the individual transmitters onboard the solar power satellite. To specify the correct amount of adjustments, the phases of the power beams from each individual transmitter arriving at the rectanna center are measured, the appropriate corrections determined, and then relayed to the satellite. The functional operation of the ground based phase control concept is summarized. The key issues examined were: measurement waveform design and selection; phase measurement pilot reference design and selection; uplink phase corrections command link format and design; and system synchronization techniques. T.M.

N81-16545*# Novar Electronics Corp., Barberton, Ohio.
AN INTERFEROMETER-BASED PHASE CONTROL SYSTEM
James H. Ott and James S. Rice *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1981 p 139-140 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

A system for focusing and pointing the SPS power beam is discussed. The system is ground based and closed loop. One receiving antenna is required on earth. A conventional uplinked data channel transmits an 8-bit phase error correction back to the SPS for sequential calibration of each power module. Beam pointing resolution is better than 140 meters at the rectenna. T.M.

N81-16546*# Novar Electronics Corp., Barberton, Ohio.
A SONIC SATELLITE POWER SYSTEM MICROWAVE POWER TRANSMISSION SIMULATION
James H. Ott and James S. Rice *In* NASA. Johnson Space Center Solar Power Microwave Transmission and Reception Dec. 1981 p 141-143 ref (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

A simulator is described which generates and transmits a beam of audible sound energy mathematically similar to the SPS power beam. The simulator provides a laboratory means for analysis of ground based closed loop SPS phase control and of ionospheric effects on the SPS microwave power beam. Author

N81-16547*# Boeing Aerospace Co., Seattle, Wash.
SPS PHASE CONTROL STUDIES
W. W. Lund, B. R. Sperber, and G. R. Woodcock *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 144-153 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

To properly point and form the satellite microwave power beam, the outputs of the power amplifiers in the transmitting array must be phased in a specific and coherent fashion. A retrodirective CW phase conjugating system using a spread spectrum uplink signal and a reference phase signal that is distributed via fiber optics, was selected as the control system for SPS. The design details are presented and applications of the system are discussed. T.M.

N81-16548*# Boeing Aerospace Co., Seattle, Wash.
SPS FIBER OPTIC LINK ASSESSMENT
T. O. Lindsay and E. J. Nalos *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1981 p 154-158 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Fiber optic technology was tentatively selected in the SPS baseline design to transmit a stable phase reference throughout microwave array. Over a hundred thousand microwave modules are electronically steered by the phase reference signal to form the power beam at the ground receiving station. The initially selected IF distribution frequency of the phase reference signal was at 980 MHz or a submultiple of it. Fiber optics offers some significant advantages in view of the SPS application. Optical transmission is highly immune to EMI/RFI, which is expected to be severe when considering the low distribution power. In addition, there are savings in both mass, physical size, and potentially in cost. T.M.

N81-16549*# Rockwell International Corp., Pittsburgh, Pa.
IONOSPHERIC EFFECTS IN ACTIVE RETRODIRECTIVE ARRAY AND MITIGATING SYSTEM DESIGN
A. K. Nandi and C. Y. Tomita *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 159-168 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The operation of an active retrodirective array (ARA) in an ionospheric environment (that is either stationary or slowly-varying) was examined. The restrictions imposed on the pilot signal structure as a result of such operation were analyzed. A 3 tone pilot beam system was defined which first estimates the total electron content along paths of interest and then utilizes this information to aid the phase conjugator so that correct beam pointing can be achieved. T.M.

N81-16550*# Boeing Aerospace Co., Seattle, Wash.
HIGH EFFICIENCY SPS KLYSTRON DESIGN
E. J. Nalos *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 175-184 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01

The most likely compact configuration to realize both high efficiency and high gain (approx. 40 dB) is a 5-6 cavity design focused by an electromagnet. The basic klystron efficiency cannot be expected to exceed 70-75% without collector depression. It was estimated that the net benefit of a 5 stage collector over a 2 stage collector is between 1.5 and 3.5 kW per tube. A modulating anode is incorporated in the design to enable rapid shutoff of the beam current in case the r.f. drive should be removed. T.M.

N81-16551*# Varian Associates, Palo Alto, Calif.
HIGH EFFICIENCY KLYSTRON FOR THE SPS APPLICATION
A. D. LaRue *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 185-205 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The enhancement of klystron efficiency through the use of collector depression, that is by recovering energy from the spent

electron beam after microwave amplification, was investigated. Design considerations included noise, harmonics, cooling, and service life. The mod anode, to be employed for beam control, and the depressed collector, used in spent electron beam energy recovery, are described. T.M.

N81-16552*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL INVESTIGATION OF EFFICIENCY AND PERFORMANCE LIMITS IN KLYSTRON AMPLIFIERS USING MULTIDIMENSIONAL COMPUTER PROGRAMS; MULTISTAGE DEPRESSED COLLECTORS; AND THERMIONIC CATHODE LIFE STUDIES
H. G. Kosmahl *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 206-213 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

An extensive parametric investigation was performed of the extraction of energy in output gaps of klystron amplifiers, using 3-D computer programs. Due to complexity of the program which used a hydrodynamic, axially and radially deformable disk ring model and the resulting long computing time, the investigation was limited to the output gap, by far the most important and difficult part of the klystron interaction. Results show that, for a confined flow focused beam throughout the penultimate cavity, radial velocities remain very small and the beam is highly laminar. It was, therefore, concluded that possible errors resulting from treating only the output cavity in 3-D would remain small. T.M.

N81-16553*# Raytheon Co., Lexington, Mass.
THE ADAPTING OF THE CROSSED-FIELD DIRECTIONAL AMPLIFIER TO THE REQUIREMENTS OF THE SPS Progress Report
William C. Brown *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 214-222 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Progress was reviewed with special emphasis upon recent developments in controlling the phase and amplitude of the microwave power output, and a perceived architecture for its placement in the subarray. Development in the critical pivotal areas of noise, potential cathode life, and efficiency are reported. T.M.

N81-16554*# Boeing Aerospace Co., Seattle, Wash.
REFERENCE SYSTEM DESCRIPTION
C. D. Lunden, W. W. Lund, and E. J. Nalos *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 227-234 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Several candidate antenna configurations are evaluated in terms of weight, efficiency, and structural rigidity. Particular emphasis is given to the waveguide slot array and its application to solar power satellites SPS. The electronic aspects of an SPS specific waveguide slot array are defined. R.C.T.

N81-16555*# Rockwell International Corp., Pittsburgh, Pa.
THE RESONANT CAVITY RADIATOR (RCR)
K. G. Schroeder, R. L. Carlise, and C. Y. Tomita *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 235-244 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The design of the resonant cavity radiator (RCR) is compared to that of the slotted waveguide array in terms of efficiency, weight, and structural integrity. It is shown that the RCR design has three significant potentials over the slotted waveguide array: (1) improvement in efficiency; (2) lighter weight; and (3) simpler structure which allows the RCR to be integrated with the RF tube to alleviate thermal interface problems. R.C.T.

N81-16556*# Raytheon Co., Lexington, Mass.
METHOD FOR PRECISION FORMING OF LOW-COST, THIN-WALLED SLOTTED WAVEGUIDE ARRAYS FOR THE SPS
William C. Brown *In* NASA. Johnson Space Center Power Satellite Microwave Transmission and Reception Dec. 1980 p 253-255 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

A method for the precision forming of thin walled, slotted waveguide arrays was devised. Models were constructed with temporary tools and evaluated. The application of the method to the solar power satellite requirements was investigated. R.C.T.

N81-16557*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
CONSIDERATION FOR HIGH ACCURACY RADIATION EFFICIENCY MEASUREMENTS FOR THE SOLAR POWER SATELLITE (SPS) SUBARRAYS
D. J. Kozakoff, J. M. Schuchardt, and C. E. Ryan *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 256-267 refs (For primary document see N81-16533 07-44)
(Contract NAS8-33605)
Avail: NTIS HC A16/MF A01 CSCL 10A

The transmit beam and radiation efficiency for 10 metersquare subarray panels were quantified. Measurement performance potential of far field elevated and ground reflection ranges and near field technique were evaluated. The state-of-the-art of critical components and/or unique facilities required was identified. Relative cost, complexity and performance tradeoffs were performed for techniques capable of achieving accuracy objectives. It is considered that because of the large electrical size of the SPS subarray panels and the requirement for high accuracy measurements, specialized measurement facilities are required. Most critical measurement error sources have been identified for both conventional far field and near field techniques. Although the adopted error budget requires advances in state-of-the-art of microwave instrumentation, the requirements appear feasible based on extrapolation from today's technology. Additional performance and cost tradeoffs need to be completed before the choice of the preferred measurement technique is finalized. R.C.T.

N81-16558*# Raytheon Co., Waltham, Mass. New Products Center.
THE HISTORY OF THE DEVELOPMENT OF THE RECTENNA
William C. Brown *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 271-280 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The history of the development of the rectenna is reviewed through its early conceptual developmental phases. Some selective aspects of the current solar power satellite rectenna development are examined. R.C.T.

N81-16559*# Boeing Aerospace Co., Seattle, Wash.
RECTENNA SYSTEM DESIGN
G. R. Woodcock and R. W. Andryczyk (General Electric Co.) *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 281-290 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The fundamental processes involved in the operation of the rectenna system designed for the solar power satellite system are described. The basic design choices are presented based on the desired microwave rf field concentration prior to rectification and based on the ground clearance requirements for the rectenna structure. A nonconcentrating inclined planar panel with a 2 meter minimum clearance configuration is selected as a representative of the typical rectenna. R.C.T.

N81-16560*# Rensselaer Polytechnic Inst., Troy, N. Y.
RECTENNA SESSION: MICRO ASPECTS
Ronald J. Gutmann *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 291-299 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Two micro aspects of the rectenna design are addressed: evaluation of the degradation in net rectenna RF to DC conversion efficiency due to power density variations across the rectenna

(power combining analysis) and design of Yagi-Uda receiving elements to reduce rectenna cost by decreasing the number of conversion circuits (directional receiving elements). The first of these micro aspects involves resolving a fundamental question of efficiency potential with a rectenna, while the second involves a design modification with a large potential cost saving. R.C.T.

N81-16561*# Novar Electronics Corp., Barberton, Ohio.
A THEORETICAL STUDY OF MICROWAVE BEAM ABSORPTION BY A RECTENNA
James H. Ott, James S. Rice, and Donald C. Thorn *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 300-306 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The results of a theoretical study of microwave beam absorption by a rectenna is given. Total absorption of power beam is shown to be theoretically possible. Several improvements in the rectenna design are indicated as a result of analytic modeling. The nature of rectenna scattering and atmospheric effects is discussed. Author

N81-16562*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Telecommunications Science and Engineering Div.
RECTENNA ARRAY MEASUREMENT RESULTS
Richard M. Dickinson *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 307-318 refs (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The measured performance characteristics of a rectenna array are reviewed and compared to the performance of a single element. It is shown that the performance may be extrapolated from the individual element to that of the collection of elements. Techniques for current and voltage combining are demonstrated. The array performance as a function of various operating parameters is characterized and techniques for overvoltage protection and automatic fault clearing in the array are demonstrated. A method for detecting failed elements also exists. Instrumentation for deriving performance effectiveness is described. Measured harmonic radiation patterns and fundamental frequency scattered patterns for a low level illumination rectenna array are presented. M.G.

N81-16563*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MICROWAVE POWER TRANSMISSION SYSTEM WORKSHOP, SESSION ON SOLID STATE
Woolsey Finnell *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 323-327 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The development of solid state technology for solar power satellite systems is briefly addressed. The economic advantages of solid state based systems are listed along with some conclusions and issues regarding specific design concepts. M.G.

N81-16564*# Boeing Aerospace Co., Seattle, Wash.
MODIFIED REFERENCE SPS WITH SOLID STATE TRANSMITTING ANTENNA
G. R. Woodcock and B. R. Sperber *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 328-337 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The development of solid state microwave power amplifiers for a solar power satellite transmitting antenna is discussed. State-of-the-art power-added efficiency, gain, and single device power of various microwave solid state devices are compared. The GaAs field effect transistors and the Si-bipolar transistors appear potentially feasible for solar power satellite use. The integration of solid state devices into antenna array elements is examined and issues concerning antenna integration and consequent satellite configurations are examined. M.G.

N81-16565*# Boeing Aerospace Co., Seattle, Wash.
SPS SOLID STATE ANTENNA POWER COMBINER
G. W. Fitzsimmons *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 338-347 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

A concept for a solar power satellite antenna power combiner which utilizes solid state dc-rf converters is described. To avoid the power combining losses associated with circuit hybrids it is proposed that the power from multiple solid state amplifiers be combined by direct coupling of each amplifier's output to the radiating antenna structure. The selected power-combining antenna consists of a printed (metalized) microstrip circuit on a ceramic type dielectric substrate which is backed by a shallow lightweight aluminum cavity which sums the power of four microwave sources. The antenna behaves like two one-half wavelength slot-line antennas coupled together via their common cavity structure. A significant feature of the antenna configuration selected is that the radiated energy is summed to yield a single radiated output phase which represents the average insertion phase of the four power amplifiers. This energy may be sampled and, by comparison with the input signal, one can phase error correct to maintain the insertion phase of all solid state power combining modules at exactly the same value. This insures that the insertion phase of each SPS power combining antenna module is identical. An experiment verification program is described. M.G.

N81-16566*# Rockwell International Corp., Pittsburgh, Pa.
SOLID STATE SYSTEMS CONCEPTS
I. K. Schroeder *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 348-357 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Two prototype solid state phased array systems concepts for potential use in the Solar Power Satellite are described; the end-mounted and the sandwich systems. In both concepts, the beam is centered on the rectenna by means of phase conjugation of a pilot signal emanating from the ground. In the end-mounted system 36-watt amplifiers are mounted on the ground-plane, whereas in the sandwich the amplifiers are elevated to the dipoles, and their waste heat is dissipated by beryllium oxide discs. The feed lines are underneath the ground-plane, and a coaxial transmission line is carried all the way to the amplifier input. Also discussed is solid state amplifier development. M.G.

N81-16567*# RCA Corp., Princeton, N. J.
SOLID STATE DEVICE TECHNOLOGY FOR SOLAR POWER SATELLITE
David G. Weir *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 358-366 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

The feasibility of using solid state elements in the solar power satellite transmitter system is addressed. Recommendations are given concerning device types, the antenna modules, and the overall antenna system. The development of a solid state amplifier based on GaAs field effect transistor devices is also described. M.G.

N81-16568*# Raytheon Co., Waltham, Mass. Equipment Div.
SOLID STATE SANDWICH CONCEPT: DESIGNS, CONSIDERATIONS AND ISSUES Progress Report
Owen E. Maynard *In* NASA. Johnson Space Center Solar Power Satellite Microwave Transmission and Reception Dec. 1980 p 367-372 (For primary document see N81-16533 07-44)
Avail: NTIS HC A16/MF A01 CSCL 10A

Progress in analysis and design of solid state approaches to the solar power satellite microwave power transmission system is reviewed with special emphasis on the Sandwich concept and the issues of maintenance of low junction temperatures for amplifiers to assure acceptable lifetime. Ten specific issues or considerations are discussed and their resolution or status is presented. Author

N81-16569*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HOUSING AUTHORITY OF BALTIMORE CITY-PUBLIC HOUSING ENERGY WORKSHOP
Thomas S. Golden, ed. 1980 49 p Workshop held at Easton,

Md., 21-23 Sep. 1980
(NASA-TM-82050) Avail: NTIS HC A03/MF A01 CSCL 10B

The NASA/Baltimore Applications Project operating at the Goddard Space Flight Center was called upon by the Housing Authority of Baltimore City to consider the problems of providing low cost public housing because of increased energy costs and suggest methods for correction and alleviation. The first step chosen was to elicit as many different options for solution as possible through means of a Public Housing Energy Workshop held in Easton, Md. in September 1980. A final role for the Workshop was a listing and qualifying of each alternative as to its suitability and cost. Specific areas were examined by three panels: (1) Systems, (2) Conservation and Motivation, and (3) Fuels. Each panel was made up of persons from differing but appropriate backgrounds; membership was not restricted to housing people alone. A summary of their deliberations is given - it will be used as a stepping stone to further selection and implementation of alternatives. Author

N81-16570*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE CALCULATIONS FOR 1000 MWe MHD/STEAM POWER PLANTS
C. C. P. Pian 1981 15 p refs Presented at the 19th Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981; sponsored by AIAA
(Contract DE-A101-77ET-10769)
(NASA-TM-81667; DOE/NASA/10769-13; E-688) Avail: NTIS HC A02/MF A01 CSCL 10B

The effects of MHD generator operating conditions and constraints on the performance of MHD/steam power plants are investigated. Power plants using high temperature combustion air preheat (2500 F) and plants using intermediate temperature preheat (1100 F) with oxygen enrichment are considered. Variations of these two types of power plants are compared on the basis of fixed total electrical output (1000 MWe). Results are presented to show the effects of generator plant length and level of oxygen enrichment on the plant thermodynamic efficiency and on the required generator mass flow rate. Factors affecting the optimum levels of oxygen enrichment are analyzed. It is shown that oxygen enrichment can reduce magnet stored energy requirement. Author

N81-16571*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OFF-DESIGN ANALYSIS OF A GAS TURBINE POWER-PLANT AUGMENTED BY STEAM INJECTION USING VARIOUS FUELS
Robert J. Stochl Nov. 1980 29 p refs
(NASA-TM-81611; E-609) Avail: NTIS HC A03/MF A01 CSCL 10B

Results are compared using coal derived low and intermediate heating valve fuel gases and a conventional distillate. The results indicate that steam injection provides substantial increases in both power and efficiency within the available compressor surge margin. The results also indicate that these performance gains are relatively insensitive as to the type of fuel. Also, in a cogeneration application, steam injection could provide some degree of flexibility by varying the split between power and process steam. T.M.

N81-16572*# General Electric Co., Cincinnati, Ohio. Advanced Energy Programs Dept.
STORAGE REQUIREMENT DEFINITION STUDY Final Report
L. E. Stacy, G. C. Wesling, and W. F. Zimmerman 15 Dec. 1980 120 p refs Sponsored by NASA and DOE Prepared for JPL
(Contract JPL-955388)
(NASA-CR-163882; AED-EO-57; JPL-9950-472) Avail: NTIS HC A06/MF A01 CSCL 10C

A dish Stirling solar receiver (DSSR) and a heat pipe solar receiver with TES (HPSR) for a 25 kWe dish Stirling solar power system are described. The thermal performance and cost effectiveness of each are analyzed minute by minute over the equivalent of one year of solar insolation. Existing designs of these two systems were used as a basis for the study; TES concepts for the DSSR and alternative TES concepts for the HPSR are presented. Parametric performance and cost studies were performed to determine the operating and cost characteristics of these systems. Data are reported for systems (1) without TES and with varying amounts of TES, (2) with and without a fossil fuel combustor, (3) with varying solar to fossil power input, and (4) with different system control assumptions. The principal effects of TES duration, collector area, engine efficiency, and fuel cost sensitivity are indicated. Development needs for each of the systems are discussed and the need and nature of possible future TES solar modular experiments are presented and discussed. Author

N81-16573*# Mathtech, Inc., Princeton, N. J.
ADVANCED COGENERATION TECHNOLOGY ECONOMIC OPTIMIZATION STUDY (ACTEOS) Final Report
Pat Nanda, Yaw Ansu, Ernest H. Manuel, Jr., and William G. Price, Jr. 15 Dec. 1980 211 p Sponsored in part by DOE Prepared for JPL
(Contract JPL-955559)
(NASA-CR-163887; Rept-2150; JPL-9950-471) Avail: NTIS HC A10/MF A01 CSCL 10B

The advanced cogeneration technology economic optimization study (ACTEOS) was undertaken to extend the results of the cogeneration technology alternatives study (CTAS). Cost comparisons were made between designs involving advanced cogeneration technologies and designs involving either conventional cogeneration technologies or not involving cogeneration. For the specific equipment cost and fuel price assumptions made, it was found that: (1) coal based cogeneration systems offered appreciable cost savings over the no cogeneration case, while systems using coal derived liquids offered no costs savings; and (2) the advanced cogeneration systems provided somewhat larger cost savings than the conventional systems. Among the issues considered in the study included: (1) temporal variations in steam and electric demands; (2) requirements for reliability/standby capacity; (3) availability of discrete equipment sizes; (4) regional variations in fuel and electricity prices; (5) off design system performance; and (6) separate demand and energy charges for purchased electricity. E.D.K.

N81-16574*# Fairchild Stratos Corp., Manhattan Beach, Calif.
DISH STIRLING SOLAR RECEIVER PROGRAM Final Report
Richard A. Haglund 15 Dec. 1980 174 p Prepared for JPL
(Contracts NAS7-100; JPL-955400)
(NASA-CR-163889; JPL-9950-473; ER-79917-3) Avail: NTIS HC A08/MF A01 CSCL 10A

A technology demonstration of a Dish Stirling solar thermal electric system can be accomplished earlier and at a much lower cost than previous planning had indicated by employing technical solutions that allow already existing hardware, with minimum modifications, to be integrated into a total system with a minimum of development. The DSSR operates with a modified United Stirling p-40 engine/alternator and the JPL Test Bed Concentrator as a completely integrated solar thermal electric system having a design output of 25 kWe. The system is augmented by fossil fuel combustion which ensures a continuous electrical output under all environmental conditions. Technical and economic studies by government and industry in the United States and abroad identify the Dish Stirling solar electric system as the most appropriate, efficient and economical method for conversion of solar energy to electricity in applications when the electrical demand is 10 MWe and less. A.R.H.

N81-16575*# Kinetic Coatings, Inc., Burlington, Mass.
DEVELOPMENT OF SIMPLIFIED PROCESS FOR ENVIRONMENTALLY RESISTANT CELLS Final Report, 8 Jun. 1978 - 30 Nov. 1980
William J. King Dec. 1980 166 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955079)
(NASA-CR-163884; DOE/JPL-955079-80/1; JPL-9950-468) Avail: NTIS HC A08/MF A01 CSCL 10A

This report describes a program to develop a simple, foolproof, all vacuum solar cell manufacturing process which can be completely automated and which results in medium efficiency cells which are inherently environmentally resistant. All components of the completed cells are integrated into a monolithic

structure with no material interfaces. The exposed materials (Si, Al2O3, Al, Ni) are all resistant to atmospheric attack and the junction, per se, is passivated to prevent long term degradation. Such cells are intended to be incorporated into a simple module consisting basically of a press formed metallic superstructure with a separated glass cover for missile, etc., protection. Author

N81-16576*# Solar Power Corp., Woburn, Mass.
DESIGN, FABRICATION, TEST, QUALIFICATION AND PRICE ANALYSIS FOR THIRD GENERATION DESIGN SOLAR CELL MODULES Final Report
15 Sep. 1980 99 p refs Sponsored in part by NASA and DOE Prepared for JPL
(Contract JPL-955403)
(NASA-CR-163917; DOE/JPL-955403-80/1; JPL-9950-464) Avail: NTIS HC A05/MF A01 CSCL 10A

An updated program plan is presented showing the task descriptions depicting the work, progress, achievements, and the cause of any deviations from the original plan (SC-1), and how this impacted on the original schedule of the program. In addition there is an update documenting all design alterations made during the pre-production phase and a complete up to date set of engineering and manufacturing documentation (CM-1). The purpose of the work in the original plan was to explore, design, develop, test, and deliver 1000 watts of prototype flat plate, photovoltaic modules appropriate for use in applications in the 20 to 500 kilowatt range and which show potential for meeting the 1986 cost goals. E.D.K.

N81-16577*# Motorola, Inc., Phoenix, Ariz. Semiconductor Group.
THE AUTOMATED ARRAY ASSEMBLY TASK OF THE LOW-COST SILICON SOLAR ARRAY PROJECT, PHASE 2 Final Report, 1 Apr. 1979 - 31 MAR. 1980
M. G. Coleman, R. A. Pryor, T. G. Sparks, R. M. Legge, and D. L. Saltzman 1980 98 p refs Sponsored by DOE Prepared for JPL
(Contract JPL-954847)
(NASA-CR-163880; DOE/JPL-954847-80/8; JPL-9950-456; Motorola-2345/8) Avail: NTIS HC A05/MF A01 CSCL 10A

Several specific processing steps as part of a total process sequence for manufacturing silicon solar cells were studied. Ion implantation was identified as the preferred process step for impurity doping. Unanalyzed beam ion implantation was shown to have major cost advantages over analyzed beam implantation. Further, high quality cells were fabricated using a high current unanalyzed beam. Mechanically masked plasma patterning of silicon nitride was shown to be capable of forming fine lines on silicon surfaces with spacings between mask and substrate as great as 250 micrometers. Extensive work was performed on advances in plated metallization. The need for the thick electroless palladium layer was eliminated. Further, copper was successfully utilized as a conductor layer utilizing nickel as a barrier to copper diffusion into the silicon. Plasma etching of silicon for texturing and saw damage removal was shown technically feasible but not cost effective compared to wet chemical etching techniques. E.D.K.

N81-16578*# RCA Labs., Princeton, N. J.
AUTOMATED ARRAY ASSEMBLY, PHASE 2 Final Report, 1 Sep. 1977 - 31 Dec. 1979
R. V. DAiello Oct. 1980 259 p refs Sponsored in part by DOE Prepared for JPL
(Contracts NAS7-100; JPL-954868)
(NASA-CR-163878; DOE/JPL-954868-80/9; JPL-9950-453) Avail: NTIS HC A12/MF A01 CSCL 10A

A manufacturing sequence which is capable of mass producing silicon solar cells is described. The sequence was arrived at after the evaluation of many processes and three related manufacturing sequences which are discussed. L.F.M.

N81-16579*# Westinghouse Electric Corp., Pittsburgh, Pa.
CELL MODULE AND FUEL CONDITIONER DEVELOPMENT Quarterly Report, Jul. - Sep. 1980
D. Q. Hoover, Jr. Oct. 1980 68 p
(Contracts DEN3-161; DE-AI03-79ET-11272)
(NASA-CR-165189; DOE/NASA/0161-5; Rept-80-9E6-MARED-R4; QR-4) Avail: NTIS HC A04/MF A01 CSCL 10A

Measurements of stack height changes with temperature and cell material characteristics were made. Stack 559 was assembled and components were fabricated for 560, 561, and 562. Stack 425 was transferred from the parallel DOE program and installed in the OS/IES simulation loop for mechanical and electrical testing. Construction and preliminary checkout of the 2 kW test facility was completed and design and procurement of the 8 kW test facility was initiated. The fuel conditioning subsystem design continued to evolve, and the state points for the current design were calculated at full and part load conditions. Steam reforming catalyst activity tests were essentially completed and aging tests and CO shift converter tests were initiated. Author

N81-16580*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTOVOLTAIC MODULE SOILING STUDIES, MAY 1978 - OCTOBER 1980
A. R. Hoffman and C. R. Maag 1 Nov. 1980 52 p refs
(Contracts NAS7-100; EX-76-A-29-1012)
(DOE/JPL-1012-49; JPL-Pub-80-87) Avail: NTIS HC A04/MF A01 CSCL 10C

Comparative electrical and optical performance data from photovoltaic modules and materials subjected to outdoor exposure at field test sites throughout the United States were collected and examined. The results show significant time and site dependence. During periods when natural removal processes do not dominate, the rate of particulate contamination accumulation appears to be largely material-independent. The effectiveness of natural removal processes, especially rain, is strongly material-dependent. Glass and acrylic top cover materials retain fewer particles than silicone rubber does. Side by side outdoor exposure testing for long duration is presently the most effective means of evaluating soiling differences between materials. Changes in spectral transmission as a function of time and location and limited scattering data are presented. Author

N81-16581*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRITERIA FOR EVALUATION OF REFLECTIVE SURFACE FOR PARABOLIC DISH CONCENTRATORS
F. Bouquet 15 Jul. 1980 67 p refs Sponsored in part by DOE
(Contracts NAS7-100)
(NASA-CR-163898; DOE/JPL-1060-39; JPL-Pub-80-81) Avail: NTIS HC A04/MF A01 CSCL 10B

Commercial, second surface glass mirror are emphasized, but aluminum and metallized polymeric films are also included. Criteria for sealing solar mirrors in order to prevent environmental degradation and criteria for bonding sagged or bent mirrors to substrate materials are described. An overview of the technical areas involved in evaluating small mirror samples, sections, and entire large gores is presented. A basis for mirror criteria was established that eventually may become part of inspection and evaluation techniques for three dimensional parabolic reflective surfaces. T.M.

N81-16582*# Boeing Aerospace Co., Seattle, Wash.
ELECTROSTATIC BONDING OF THIN (CYCLE SINE 3 MIL) 7070 COVER GLASS TO Ta2O5 AR-COATED THIN (CYCLE SINE 2 MIL) SILICON WAFERS AND SOLAR CELLS
D. W. Egelkrout Jan. 1981 77 p refs
(Contract NAS3-22216)
(NASA-CR-165240; D180-26200-1) Avail: NTIS HC A05/MF A01 CSCL 10A

Electrostatic bonding of thin cover glass to thin solar cells was researched. Silicon solar cells, wafers, and Corning 7070 glass of from about 0.002' to about 0.003' in thickness were used in the investigation to establish optimum parameters for producing mechanically acceptable bonds while minimizing thermal stresses and resultant solar cell electrical parameter degradation. E.D.K.

N81-16583*# Ionics, Inc., Watertown, Mass.
ANION PERMSELECTIVE MEMBRANE Summary Report
Russell B. Hodgdon and Warren A. Waite Nov. 1980 54 p refs
(Contracts DEN3-137; DE-AI04-80AL-12726)

(NASA-CR-165223; DOE/NASA/0137-1) Avail: NTIS HC A04/MF A01 CSCL 10A

The efforts on the synthesis of polymer anion redox membranes were mainly concentrated in two areas, membrane development and membrane fabrication. Membrane development covered the preparation and evaluation of experimental membranes systems with improved resistance stability and/or lower permeability. Membrane fabrication covered the laboratory scale production of prime candidate membranes in quantities of up to two hundred and sizes up to 18 inches x 18 inches (46 cm x 46 cm). These small (10 in x 11 in) and medium sized membranes were mainly for assembly into multicell units. Improvements in processing procedures and techniques for preparing such membrane sets lifted yields to over 90 percent. T.M.

N81-16584*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DEVELOPMENT AND TESTING OF HEAT TRANSPORT FLUIDS FOR USE IN ACTIVE SOLAR HEATING AND COOLING SYSTEMS Final Report

John C. Parker Jan. 1981 43 p Sponsored in cooperation with DOE Prepared in part by Houston Chemical Corp., Corpus Christi, Tex.

(Contract NAS8-32255)

(NASA-TM-82395) Avail: NTIS HC A03/MF A01 CSCL 10B

Work on heat transport fluids for use with active solar heating and cooling systems is described. Program objectives and how they were accomplished including problems encountered during testing are discussed. S.F.

N81-16585# Committee on Energy and Natural Resources (U.S. Senate).

ENERGY IN TRANSITION, 1985-2010

Washington GPO 1980 64 p refs Hearing before the Comm. on Energy and Nat. Resources, 96th Congr., 2nd Sess., 18 Apr. 1980

(GPO-63-171; Publ-96-110) Avail: Committee on Energy and Natural Resources

Highlights of the Committee on Nuclear and Alternative Energy Systems' (CONAES) report are summarized. A variety of energy futures are discussed with respect to their political desirability and feasibility. The social acceptability attached to the risks involved in each of the possible energy futures was examined. Policies were determined with regard for the flexibility to change the direction of growth and research in the future. T.M.

N81-16586# Naval Research Lab., Washington, D. C. Radiation Effects Branch.

RESULTS OF THE SOLAR CELL EXPERIMENTS ABOARD THE NTS-2 SATELLITE AFTER 811 DAYS IN ORBIT Interim Memorandum Report, 1 Oct. 1978 - 30 Sep. 1979

Delores H. Walker 13 Nov. 1980 45 p refs

(AD-A092438; NRL-MR-4372; AR-2) Avail: NTIS HC A03/MF A01 CSCL 10/2

The performance and radiation hardness of state-of-the-art solar cells in the space environment were evaluated. The experiment consisted of 15 separate experimental modules each containing five 2x2 cm solar cells connected in series. The solar cell types included the Comsat CNR cell, the Spectrolab Textured Helios Reflector cell, and the Solarex Vertical Junction cell. The Hughes gallium-arsenide/gallium-aluminum-arsenide cell was also included in the flight experiment. There were also on board experiments to evaluate the environmental effects on coverslip adhesives. T.M.

N81-16587# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Meteorology.

ENVIRONMENTAL INFLUENCES IN THE SIMULATION OF A SOLAR SPACE HEATING SYSTEM M.S. Thesis - Oklahoma Univ.

Douglas M. Brooks 1980 132 p refs

(AD-A092436; AFIT-CI-80-20T) Avail: NTIS HC A07/MF A01 CSCL 13/1

The objective of this thesis was to determine whether hourly departures in building heat loss given by a simplified degree day approach has a significant effect on the selection of an optimum collector size for the solar system. A numerical model was to do simulation studies. Using the results from this simulation an optimum collector size was determined from the energy requirements given by each model and a comparison made between the simulations and the degree day approaches. GRA

N81-16588# Texas Univ. at Austin. Dept. of Chemistry.

ON THE ROLE OF SURFACE STATES IN SEMICONDUCTOR ELECTRODE PHOTOELECTOCHEMICAL CELLS Technical Report, 1 Sep. 1980 - 31 Aug. 1981

Allen J. Bard, Fu-Ren F. Fan, Alberto S. Gioda, G. Nagasubramanian, and Henry S. White 27 Oct. 1980 22 p refs Submitted for publication Sponsored in part by NSF and the Solar Energy Research Inst.

(Contract N00014-78-C-0592)

(AD-A091958; TR-13) Avail: NTIS HC A02/MF A01 CSCL 20/12

Surface states that occur at the semiconductor-liquid interface play an important role in the behavior of that interface and affect the efficiency of photoelectrochemical solar devices. The nature of such states and evidence for their existence will be briefly reviewed. Their role in dark electron transfer reactions for redox couples with energies within the band-gap region and in mediating surface recombinations will be discussed. The importance of Fermi level pinning by surface states at moderate densities in GaAs and Si in controlling the open-circuit photovoltage and the observed electrochemical behaviour will be described. The effect of the surface pretreatment on the photoelectrochemical behavior of p-GaAs and n-WSe2 will be demonstrated. GRA

N81-16589# Energy Research Corp., Danbury, Conn.

IMPROVEMENT OF PHOSPHORIC ACID FUEL CELL STACKS Final Technical Report, Aug. 1977 - Jun. 9180

S. G. Abens, F. J. Ascenzo, B. S. Baker, G. Garretson, and M. Lambrech Jul. 1980 88 p

(Contract DAAK70-77-C-0174; DA Proj. 1L2-63702-DG-10)

(AD-A092814) Avail: NTIS HC A05/MF A01 CSCL 10/2

Phosphoric acid fuel cell components and stack assembly methods were evaluated. Electrodes with Pt loading between 0.3 and 0.9 g/sq. ft were employed. Matrix materials were phenolic (Kynol) fibers and SiC. A new ERC proprietary matrix was used also. Graphite bipolar plates with 33% phenolic resin binder were used. Stacks were tested on hydrogen and simulated reformed methanol for up to 18,000 hours. Two 80 cell (2.1 kW) stacks and a methanol reformer were built and delivered to MERADCOM. GRA

N81-16590# RCA Labs., Princeton, N. J. Display and Energy Systems Research Lab.

AMORPHOUS BORON-SILICON-HYDROGEN ALLOYS FOR THIN FILM HETEROJUNCTION SOLAR CELLS Quarterly Technical Progress Report, 1 Jun. - 31 Aug. 1980

A. R. Moore, D. E. Carlson, and R. W. Smith Sep. 1980 20 p refs Sponsored by Solar Energy Research Inst.

(SERI/PR-0-9010-1; QTPR-1) Avail: NTIS HC A02/MF A01

Amorphous boron silicon hydrogen films were grown in dc proximity glow discharges in atmospheres containing B2H6, SiH4 and H2. The films are p-type and exhibit conductivities. They do not exhibit any significant photoconductivity or photoluminescence. S.F.

N81-16591# Argonne National Lab., Ill. Advanced Battery Projects Dept.

LITHIUM/IRON SULFIDE BATTERIES FOR ELECTRIC-VEHICLE PROPULSION AND OTHER APPLICATIONS Progress Report, Oct. 1979 - Mar. 1980

D. L. Barney, R. K. Steunenberg, A. A. Chilenskas, E. C. Gay, J. E. Battles, W. E. Miller, D. R. Vissers, and H. Shimotake Aug. 1980 105 p refs

(ANL-80-49) Avail: NTIS HC A06/MF A01

Research and development activities on lithium/iron sulfide batteries are described. Although the major emphasis is currently on batteries for electric vehicle propulsion, stationary energy storage applications are also under investigation. The individual battery cells, which operate at 400-500 C, are of a vertically oriented, prismatic design with two or more positive electrodes of FeS or FeS2, facing negative electrodes of lithium aluminum or lithium silicon alloy, and molten LiCl-KCl electrolyte. Effects of design modifications on cell performance and post test

examinations of cells are included. Efforts to develop high reliability cells having boron nitride felt separators are described. S.F.

N81-16592# Sandia Labs., Albuquerque, N. Mex. Photovoltaics Div.
DESIGN, FABRICATION, AND PERFORMANCE OF A 20 PERCENT EFFICIENT SILICON SOLAR CELL
J. L. Rodriguez and F. W. Sexton Oct. 1980 26 p refs
(Contract DE-AC04-76DP-000789)
(SAND-80-2225) Avail: NTIS HC A03/MF A01

A single crystal concentrator p(+)nn(+) silicon solar cell with maximum efficiency greater than 20% at 27 C is described. The intrinsic cell design was used with several metallization patterns targeted for different system designs in the ten to several hundred sums concentration range. The design and fabrication of the intrinsic cell is specified. Performance data for the best cells of three metal patterns with the intrinsic cell are presented and discussed. Author

N81-16593# Sandia Labs., Albuquerque, N. Mex. Experimental Systems Operations Div.
PERFORMANCE OF A SOLAR-HEATED ASSEMBLY BUILDING AT SANDIA NATIONAL LABORATORIES
Dale E. Haskins Sep. 1980 44 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0599) Avail: NTIS HC A03/MF A01

The passive solar heating system of the assembly building at Sandia National Laboratories' Photovoltaic Advanced Systems Test Facility is described and the thermal analysis of the building is given. Performance predictions are also given, and actual performances for December 1979 and January 1980 are shown. E.D.K.

N81-16594# Oak Ridge National Lab., Tenn.
APPLICATIONS OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION Progress Report, 1 Mar. 1980 - 28 Feb. 1981
R. T. Young, D. H. Lowndes, and R. F. Wood 17 Nov. 1980 18 p Presented at Topical Polycrystalline Silicon Subcontractors' Rev. Meeting, Colorado Springs, Colo., 17 Nov. 1980
(Contract W-7405-eng-26)
(CONF-801153-1) Avail: NTIS HC A02/MF A01

Laser annealing and laser induced diffusion can be used to control grain boundary diffusion and segregation. With these techniques, the near surface region of a sample actually melts but stays molten for such a short time that significant dopant migration cannot occur. Furthermore, since the grain boundaries as such do not exist while the material is molten, rapid diffusion to them and along them does not occur. Laser techniques can also be used to promote growth, and evidence from EBIC and TEM indicates that pulsed laser annealing changes the elementary structure of some types of grain boundaries. The role of lithium in polycrystalline Si was studied. It was found that when Li is added to polycrystalline Si, it not only provides an excess free carrier for each ionized Li, but also dramatically improves the carrier mobilities. A.R.H.

N81-16595# Research Triangle Inst., Research Triangle Park, N. C. Semiconductor Research Dept.
RESEARCH ON HIGH EFFICIENCY CASCADE SOLAR CELLS Annual Report, Jul. 1979 - Jun. 1980
S. M. Bedair, M. L. Timmons, J. R. Hauser, J. E. Andrews, S. B. Phatak, and M. Simons Aug. 1980 103 p refs Prepared in cooperation with North Carolina State Univ., Raleigh
(Contract EG-77-C-01-4042)
(SERI/PR-8136-1-T1) Avail: NTIS HC A06/MF A01

The technology needed to fabricate two junction cascade solar cells having conversion efficiencies of 30 percent or more under multisun illumination was researched using a number of different III-V semiconductor materials systems that are potential candidate for a cascade solar cell design. Work focused on the development of a compatible combination of materials required for the monolithic, multilayer structure using several different epitaxial growth techniques. Materials receiving principal attention during the past year have been GaAlAs, GaInP, and GaAlAsSb for the high bandgap top cell and GaInAs, GaAsSb, and GaAs for the low bandgap bottom cell. Liquid phase, vapor phase, and organometallic chemical vapor deposition growth techniques were explored. E.D.K.

N81-16596# Columbia Univ., New York.
FUNDAMENTAL STUDIES OF M-S AND MIS SOLAR CELLS ON POLYCRYSTALLINE SILICON Final Report, 1 Jan. 1979 - 30 Jun. 1980
Edward S. Yang and Howard C. Card Oct. 1980 131 p refs
(Contract DE-AC03-79ET-23049)
(DOE/ET-23049/T1) Avail: NTIS HC A07/MF A01

A technique plotting the open circuit voltage vs short circuit current at varying illumination intensity is found to provide a better description of the solar cells when the n value reflects the electrostatic potential drop across the interface layer in MIS structures. The majority carrier MIS cell was found to be less sensitive to the parameters of the oxide layer, but to have a somewhat lower efficiency than the minority carrier cell. The tunneling barriers for holes are found to be consistently much larger than those for electrons. Experimental I-V and C-V characteristics of Schottky diodes with variable grain sizes were measured and Al-poly-Si Schottky barrier diodes on Wacker polycrystalline wafers were fabricated. E.D.K.

N81-16597# Oak Ridge National Lab., Tenn. Operations Div.
RADIOISOTOPE POWERED LIGHT SOURCES
F. N. Case and W. C. Remini 1980 14 p Sponsored in part by USAF
(Contract W-7405-eng-26)
(CONF-801157-1) Avail: NTIS HC A02/MF A01

The background and current status of the use of radioisotopes to excite phosphors to produce visible light are discussed. Current energy conservation needs provided the incentive for the development of illuminators for air field markers using both byproduct krypton-85 and processed tritium. L.F.M.

N81-16598# United Technologies Corp., South Windsor, Conn. Power Systems Div.
IMPROVED FCG-1 CELL TECHNOLOGY Final Report, 1 Mar. - 31 Dec. 1979
R. D. Breault, J. V. Congdon, R. D. Coykendall, and W. L. Luoma Oct. 1980 49 p Sponsored in part by Electric Power Research Inst.
(Contract DE-AC03-76ET-11301; EPRI Proj. 842-5)
(EPRI-EM-1566) Avail: NTIS HC A03/MF A01

Fuel cell performance in the ribbed substrate cell configuration consistent with tha5 projected for a commercial power plant is demonstrated. Tests were conducted on subscale cells and on two 20 cell stacks of 4.8 MW demonstrator size cell components. These tests evaluated cell stack materials, processes, components, and assembly configurations. The first task was to conduct a component development effort to introduce improvements in 3.7 square foot, ribbed substrate acid cell repeating parts which represented advances in performance, function, life, and lower cost for application in higher pressure and temperature power plants. Specific areas of change were the electrode substrate, catalyst, matrix, seals, separator plates, and coolers. Full sized ribbed substrate stack components incorporating more stable materials were evaluated at increased pressure (93 psia) and temperature (405 F) conditions. Two 20 cell stacks with a 3.7 square feet, ribbed substrate cell configuration were tested. S.F.

N81-16599# Battelle Pacific Northwest Labs., Richland, Wash.
LABORATORY STUDIES OF HARD ROCK FOR CAES
Arlo F. Fossum Oct. 1980 7 p
(Contract DE-AC06-76RL-01830)
(PNL-SA-8971) Avail: NTIS HC A02/MF A01

The properties of hard rock specimens, from formations suitable for compressed air energy storage (CAES) that are subject to the conditions envisioned for a CAES cavern, were investigated by means of laboratory testing. It was concluded that although the compressive and tensile strengths are adversely influenced by a CAES cavern environment, the reduced failure strength of hard rocks is sufficiently high to indicate that a CAES plant could be operated satisfactorily. L.F.M.

N81-16600# Battelle Pacific Northwest Labs., Richland, Wash.
COMPRESSED AIR ENERGY STORAGE TECHNOLOGY

PROGRAM OVERVIEW
W. V. Loscutoff and L. D. Kannberg Oct. 1980 6 p refs
(Contract DE-AC06-76RL-01830)
(PNL-SA-8988) Avail: NTIS HC A02/MF A01

Studies were conducted to develop stability criteria for long-term operation of large underground reservoirs used for compressed air storage and to develop new concepts that will require little or no petroleum fuels for operation. Major accomplishments during FY-80 are presented, and future activities required to meet objectives are identified. L.F.M.

N81-16601# Union Coll., Schenectady, N.Y. Dept. of Mechanical Engineering.
CONTINUED DEVELOPMENT OF THE BAND TYPE VARIABLE INERTIA FLYWHEEL Final Report
David G. Ullman and John Corey 1980 152 p refs Prepared in cooperation with Mechanical Technology, Inc.
(UCRL-15303) Avail: NTIS HC A08/MF A01

The band-type variable-inertia flywheel (BVIF) is introduced and previous development is recited. Three dynamic analyses are presented in preparation for system design. An important conceptual breakthrough is reported in the characterization of the BVIF as not one but two flywheels capable of exchanging mass and energy. Three types of BVIF's are studied with conclusions presented regarding the suitability of each to actual usefulness. An open loop system (Type 1) is found to have potential for acceleration of inertial loads, but to experience mechanical instability. A one degree of freedom BVIF (Type 2) is briefly considered and found to be capable of approximately constant speed operation. Finally, a power-recirculating (closed loop) two degree of freedom BVIF (Type 3) is found to possess the described ability to smoothly accelerate inertial loads but without the inherent instability of the Type 1. E.D.K.

N81-16602# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
AIR/GAS SYSTEM DYNAMICS OF FOSSIL FUEL POWER PLANTS. VOLUME 4: EXPERIMENTAL VIBRATION AND ACOUSTIC TEST DATA OF A 500-MW UNIT Interim Report
F. R. Goldschmied, D. N. Wormley, and D. Rowell Oct. 1980 174 p refs Prepared in cooperation with MIT, Cambridge
(EPRI Proj. 1651)
(EPRI-CS-1444-Vol-4) Avail: NTIS HC A08/MF A01

Vibration and acoustic tests were made in a 500 MW oil fired unit, in conjunction to system dynamics pressure data. The test data were taken on one forced draft fan, on one induced draft fan and on the gas recirculation fan. Both cold tests and hot tests were taken for all fans. Identical fans were used for forced draft and for induced draft installation but the acoustic characteristics were different. A total of 145 spectrum plots are presented. Twenty five vibration spectrums are given, where acceleration level, g, is plotted against frequency; two frequency ranges are used, 0-20 Hz and 0-200 Hz. One hundred and twenty acoustic spectrums are given, where sound level, is plotted against frequency; three frequency ranges are used; 0-20 Hz, 0-200 Hz, and 0-2000 Hz. The test data are presented for future reference without concomitant analysis at this time.
Author

N81-16603# Houston Univ., Tex.
ENERGY SUPPLY AND DEMAND PROPERTIES FROM ENGINEERING PROCESS MODELS Final Report
R. G. Thompson, S. Muthukrishnan, F. D. Singleton, Jr., and J. C. Stone Jan. 1980 171 p refs
(EPRI Proj. 1055-1)
(EPRI-EA-1568) Avail: NTIS HC A08/MF A01

Energy supplies and demands are studied by use of process models. A process mode represents a synthesis of engineering and economic principles into a mathematical model of production. The mathematical procedure employed is linear programming. The distinguishing features of this method are: (1) the representation of specific processes by vectors of fixed coefficients which describe the inputs, outputs and costs of each process; and (2) the mathematical structuring of these process representations in such a way as to impose relevant economic, engineering, and policy constraints on the choice of process alternatives. Solution of the linear programming model for its minimum cost solution gives the economically efficient way to produce the required outputs within the limitations of externally imposed economic and regulatory constraints. S.F.

N81-16604# Los Alamos Scientific Lab., N. Mex.
CONSTRAINTS TO BIO-ENERGY DEVELOPMENT
Virginia Barber Parsons 1980 9 p refs Presented at the 3rd Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract W-7405-eng-36)
(LA-UR-80-3387; CONF-801210-7) Avail: NTIS HC A02/MF A01

The energy crisis has prompted research and development of renewable, domestic, cost effective, and publicly acceptable energy alternatives. Among these are the bioconversion technologies. To date bioenergy research has been directed toward the mechanics of the conversion processes and technical assessment of the environmental impacts. However, there are other obstacles to overcome before biomass can be converted to more useful forms of energy that fit existing need. Barriers to bioenergy resource application are identified. In addition, examples from several agricultural regions serve to illustrate site specific resource problems. E.D.K.

N81-16605# Los Alamos Scientific Lab., N. Mex.
ENERGY, HELIUM, AND THE FUTURE, 2
Milton C. Krupka and Edward F. Hammel 1980 23 p refs Presented at Third Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract W-7405-eng-36)
(LA-UR-80-3342; CONF-801210-6) Avail: NTIS HC A02/MF A01

Potential supplies of helium from both conventional and unconventional natural gas resources, projected supply/demand relationships to the year 2030 based upon a given power generation scenario, projected helium demand for specific energy related technologies and the supply options available to meet that demand are discussed. An updated review is given of the energy requirements for the extraction of helium from natural gas as they relate to the concentration of helium. The technical and economic feasibility of several methods available both now and conceptually possible to extract helium from helium lean natural gas, the atmosphere and outer space is discussed. A brief review is given of the 1980 congressional activities with respect to the introduction and possible passage of helium conservation legislation. E.D.K.

N81-16606# Ames Lab., Iowa.
PHOTOELECTROCHEMICAL SOLAR CELLS BASED ON d-BAND ELECTROCHEMISTRY AT TRANSITION METAL DISELENIDES Technical Progress Report, 1 Dec. 1979 - 29 Feb. 1980
Bruce A. Parkinson and Thomas E. Furtak May 1980 32 p refs
(Contract EG-77-C-01-4042)
(IS-4745) Avail: NTIS HC A03/MF A01

Topographic photogenerated carrier collection analysis and sub bandgap photoexcitation studies have confirmed that edge states associated with lattice imperfections on WSe2 are the principal detrimental factor contributing to poor power conversion efficiency in photoelectrochemical solar cells based on this material. Efficiency improvement was achieved by inactivating the edge states. Author

N81-16607# Sandia Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC ADVANCED SYSTEMS TEST FACILITY: DESCRIPTION AND OPERATIONS PLAN
Howard J. Gerwin Oct. 1980 46 p Sponsored by DOE
(SAND-80-1612) Avail: NTIS HC A03/MF A01

The Photovoltaic Advanced Systems Test Facility is described. Photovoltaic modules and arrays are tested, along with power conditioning units and energy storage equipment related to photovoltaic systems. The test facility description, collector test plan, and user interface information are presented. S.F.

N81-16608# Sandia Labs., Albuquerque, N. Mex. Geo Energy Systems Analysis Div.
COMPARATIVE ANALYSIS OF COMBINED FLAT-PLATE

PV/T COLLECTORS WITH SEPARATE PV/T COLLECTORS
Eddie R. Hoover Sep. 1980 44 p refs Sponsored by DOE
(SAND-80-1494) Avail: NTIS HC A03/MF A01

The conditions under which a combined photovoltaic/thermal (PV/T) collector is more cost effective than separate flat plate photovoltaic and thermal collectors are determined. The annual performance of the separate PV/T system and four different combined PV/T systems are simulated in two geographical locations using a system analysis computer program. Based on equivalent electrical and thermal outputs and the 1986 DOE goal for PV modules (70 cents/Wp), the maximum allowabe incremental cost to upgrade the conventional thermal collector to a combined PV/T collector is determined. For all of the cases considered, the separate PV/T collectors are more cost effective than the combined PV/T collectors. E.D.K.

N81-16609# Stanford Linear Accelerator Center, Calif.
ULTRA HEADLESS HYDRO POWER
F. F. Hall Sep. 1980 4 p refs Presented at 3rd Intern. Conf. on Alternative Sources, Miami Beach, Fla., 15-17 Dec. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-Pub-2613; CONF-801210-3) Avail: NTIS HC A02/MF A01

Site selection considerations were reviewed for hydroelectric power stations. Design factors influencing energy conversion efficiency are presented. Electric energy storage technology was reviewed. Principles for the ultimate attainment of hydropower from the least head are discussed. T.M.

N81-16610# Westinghouse Research and Development Center, Pittsburgh, Pa.
DEVELOPMENT OF COPPER SULFIDE/CADMIUM SULFIDE THIN FILM SOLAR CELLS Technical Progress Report, 13 Oct. 1979 - 12 Jan. 1980
J. R. Szedon, F. A. Shirland, J. A. Stoll, and H. C. Dickey 31 Mar. 1980 32 p refs
(SERI/PR-8143-1-T1; TPR-2) Avail: NTIS HC A03/MF A01

Two differences have been found in comparisons of CdS films deposited by single source and four source methods: the latter show evidence of greater structural imperfection at the grain level and produce cells which develop nearly full photovoltaic performance after much shorter air heat treatment at 250 C than do cells in single source material. A model is proposed to account for the greater structural disorder in the multisource film. Cells on single source CdS films deposited on copper with a thin (0.3 micrometers) zinc plating have exhibited 3.3 percent efficiency, with improvement to be expected by optimized annealing. Author

N81-16611# National Inst. of Building Sciences, Washington, D. C.
RESIDENTIAL ENERGY EFFICIENCY STANDARDS STUDY: TECHNICAL ANALYSIS
Jun. 1980 370 p refs
(Contract HUD-HC-5040)
(PB81-106981; HUD-0001671) Avail: NTIS HC A16/MF A01 CSCL 13A

The need for, the feasibility of, and the problems of requiring, by mandatory federal action, that all residential dwelling units meet applicable, energy efficiency standards was determined. The potential requirements of mandatory energy efficiency standards was identified. The incremental energy savings and investment cost of mandatory standards for 1981 through 1990 was estimated. The impact of estimated, maximum incremental energy savings and investment cost of standards on the entire economy was assessed. GRA

N81-16612# National Bureau of Standards, Washington, D.C. National Engineering Lab.
THE NBS ENERGY MODEL ASSESSMENT PROJECT: SUMMARY AND OVERVIEW
S. I. Gass, K. L. Hoffman, R. H. F. Jackson, L. S. Joel, and P. B. Saunders Sep. 1980 43 p refs Sponsored in part by DOE
(PB81-105082; NBSIR-80-2128) Avail: NTIS HC A03/MF A01 CSCL 10A

The activities and technical reports for the project are summarized. The reports cover: assessment of the documentation of Midterm Oil and Gas Supply Modeling System; analysis of the model methodology characteristics of the input and other supporting data; statistical procedures undergirding construction of the model and sensitivity of the outputs to variations in input, as well as guidelines and recommendations for the role of these in model building and developing procedures for their evaluation. GRA

N81-16613# National Technical Information Service, Springfield, Va.
SOLAR ENERGY CONCENTRATOR DESIGN AND OPERATION. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Jul. 1980
Audrey S. Hundemann Sep. 1980 170 p Supersedes NTIS/PS-79/0926 and NTIS/PS-78/0838
(PB80-813942; NTIS/PS-79/0926; NTIS/PS-78/0838) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Government funded research on the design and operation of various types of solar energy concentrators is discussed. Abstracts cover the efficiency and optimization of Fresnel lenses, V-through concentrators, flat plate and parabolic reflectors, compound parabolic concentrators used in solar photovoltaic conversion and heliostat systems. A few abstracts deal with heat loss and cost studies. GRA

N81-16614# Gamze-Korobkin-Caloger, Inc., Washington, D.C.
ANALYSIS OF RESIDENTIAL DUCT LOSSES Final Report, Mar. 1979 - Apr. 1980
Joseph A. Orlando, Maurie G. Gamze, N. Malik, R. Crews, G. Michaels, and J. Christie Aug. 1980 219 p refs Sponsored by Gas Research Inst.
(PB80-228000; Rept-9240-2; GRI-79/0037) Avail: NTIS HC A10/MF A01 CSCL 08M

To assess the impact of measured duct losses on energy consumption, it is necessary to consider the duct system as but one element in the residential environmental control system that includes both the building frame and the furnace. Based on data collected in this effort, it was concluded that duct systems should include return registers in each room and balancing dampers in all supply branches. This will increase occupant comfort and decrease heating costs. It may also improve the performance of a central air conditioning system. It was also found that taping and insulating duct-work can produce meaningful energy savings, while the use of outside air for combustion was of minor consequence. GRA

N81-16615# National Technical Information Service, Springfield, Va.
HYDROCARBON FUEL CELLS. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1967 - Jul. 1980
Diane M. Cavagnaro Oct. 1980 135 p Supersedes NTIS/PS-79/0718 and NTIS/PS-78/0651
(PB81-800021; NTIS/PS-79/0718; NTIS/PS-78/0651) Avail: NTIS HC $30.00/MF $30.00 CSCL 10B

This bibliography cites worldwide research on hydrocarbon fuel cells. The citations cover applications, design, performance, fabrication, catalysts, and electrochemistry. This updated bibliography contains 130 citations, 2 of which are new entries to the previous edition. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N81-16616*# National Aeronautics and Space Administration, Washington, D. C.
THE 1980 JANNAF SAFETY AND ENVIRONMENTAL PROTECTION SUBCOMMITTEE MEETING
John A. E. Hannum, ed. Oct. 1980 128 p refs Meeting held at Wright-Patterson AFB, Ohio, 22-24 Jul. 1980; sponsored by Army, Navy, NASA and Air Force Prepared in cooperation with APL, Laurel, Md.
(Contract N00024-78-C-5384)
(NASA-TM-82240; AD-A094968; CPIA-PUB-325) Avail:

Chemical Propulsion Information Agency CSCL 13B

Oncogenic hazards of hydrazine inhalation, air dispersion modeling, and hazardous waste legislation are discussed. Other topics include toxic vapor detector development, effects of acid rain from solid propellants on citrus trees, debris hazards to Sun synchronous spacecraft, inadvertent weather modification, and ice forming nuclei from solid rocket propellant exhaust. For individual titles, see N81-16617 through N81-16623.

N81-16617*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

INSTRUMENT DEVELOPMENT FOR A TOXIC LEVEL HYPERGOLIC VAPOR DETECTOR

Perry M. Rogers, Joseph R. Stetter, Ying-Kit Lau (Dickinson and Co., Hawthorne, N.Y.), and Raymond B. Cromer *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcom. Meeting Oct. 1980 P 1-22 refs (For primary document see N81-16616 07-45)

Avail: Chemical Propulsion Information Agency CSCL 13B

The development and deployment of technology applicable to the field measurement of hypergolic propellants is discussed. The propellants include hydrazine (H) monomethylhydrazine (MMH), and 1,1-dimethylhydrazine (UDMH) at the parts per billion (PPB) level in air or a diluent gas. Four major areas are reviewed: (1) development of an improved electrochemical sensor for the measurement of hydrazines (H, MMH and UDMH) in air; (2) prototype instrument fabrication and subsequent laboratory evaluation; (3) initial instrument field test results; and (4) future requirements and applications. E.D.K.

N81-16618*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

RESPONSE OF CITRUS AND OTHER SELECTED PLANT SPECIES TO SIMULATED HCL - ACID RAIN

W. M. Knott (North Carolina State Univ., Raleigh) and A. S. Heagle *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm. Meeting Oct. 1980 p 23-40 refs (For primary document see N81-16616 07-45)

Avail: Chemical Propulsion Information Agency CSCL 13B

Mature valencia orange trees were sprayed with hydrochloric acid solutions (pH 7.8, 2.0, 1.0, and 0.5) in the field at the full bloom stage and at one month after fruit set. Potted valencia orange and dwarf citrus trees, four species of plants native to Merritt Island, and four agronomic species were exposed to various pH levels of simulated acid rain under controlled conditions. The acid rain was generated from dilutions of hydrochloric acid solutions or by passing water through an exhaust generated by burning solid rocket fuel. The plants were injured severely at pH levels below 1.0, but showed only slight injury at pH levels of 2.0 and above. Threshold injury levels were between 2.0 and 3.0 pH. The sensitivity of the different plant species to acid solutions was similar. Foliar injury symptoms were representative of acid rain including necrosis of young tissue, isolated necrotic spots or patches, and leaf abscission. Mature valencia orange trees sprayed with concentrations of 1.0 pH and 0.5 pH in the field had reduced fruit yields for two harvests after the treatment. All experimental trees were back to full productivity by the third harvest after treatment. Author

N81-16619*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Space Sciences Lab.

UTILIZATION OF THE NASA/MSFC DIFFUSION MODEL IN SUPPORT OF AEROSPACE AIR QUALITY ANALYSES

J. B. Stephens *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm. Meeting Oct. 1980 p 41-48 refs (For primary document see N81-16616 07-45)

Avail: Chemical Propulsion Information Agency CSCL 13B

The basic types of diffusion models available for aerospace air quality analyses are reviewed in terms of meteorological input differences. The NASA/MSFC rocket exhaust effluent diffusion (REED) code is summarized and discussed as a tool for aerospace air quality analyses. The generic approach to a climatological air quality analysis using the NASA/MSFC REED code is considered. Author

N81-16620# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

CLOUD FORMING NUCLEI FROM COMBUSTION OF SOLID-ROCKET-MOTOR PROPELLANTS

Edward E. Hindman, II and William G. Finnegan *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm. Meeting Oct. 1980 p 49-55 refs (For primary document see N81-16616 07-45)

Avail: Chemical Propulsion Information Agency CSCL 13B

Laboratory and field investigations have shown that the combustion aerosols from cast composite propellants containing aluminum and ammonium perchlorate produce large numbers of both cloud condensation nuclei (CCN) and ice forming nuclei (IFN). Exhaust clouds from nozzle up firings of super HIPPO motors contain high concentrations of IFN and the numbers found are consistent with laboratory estimates. Further, field measurements have shown that Titan 3 launch clouds contain large numbers of IFN. These results imply that frequent launches of shuttle vehicles planned for the 1980's will release meteorologically significant concentrations of IFN and may result in changes in physical processes of naturally occurring clouds. One such cloud was seeded with the combustion aerosol from shuttle booster propellant and found to contain anomalously high concentrations of ice crystals. Author

N81-16621# Aerospace Corp., Los Angeles, Calif.

APPLICATION OF VAPOR-LIQUID EQUILIBRIUM (HENRY'S LAW) DATA FOR HYDRAZINE FUELS TO THE DESIGN OF GAS SCRUBBERS

A. M. Baumgartner, M. P. Easton, and M. H. Mach *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm. Meeting Oct. 1980 p 57-69 refs (For primary document see N81-16616 07-45)

(Contract F04701-78-C-0079)

Avail: Chemical Propulsion Information Agency CSCL 13B

Henry's Law constants, $k = P/X$, where P is the vapor pressure of the solute and X its mole fraction, were determined for aqueous solutions of hydrazine and monomethylhydrazine (MMH). Measurements were performed at 10 C, 20 C, and 30 C on 1.0%, 0.50%, 0.25%, and 0.10% W/W solutions, buffered at pH 7 and unbuffered. The effect of 1% and 2% added sodium chloride on the unbuffered solutions at 20 C was also evaluated. Values of k (atm/mole fraction) are relatively independent of concentration. The highest values of k were found at 30 C for the unbuffered solutions; buffering at pH 7 reduced the k's by about a factor of 10. A plot of log k versus 1/T gave the following values of the heat of vaporization, for the buffered and unbuffered solutions respectively: hydrazine, 8.6 and 9.3; MMH 5.9 and 7.4. At 20 C, sodium chloride reduced k for the 0.1% hydrazine and MMH solutions by ca. 50%. This effect was less pronounced at higher fuel concentrations. The experimentally determined k values for hydrazine and MMH are approximately 5% of the vapor pressure to be expected based on Raoult's Law. Thus, solvation of the amine fuels by water substantially reduces their concentrations in the vent gas. E.D.K.

N81-16622# Battelle Columbus Labs., Ohio.

THE HAZARD PRESENTED TO SUN-SYNCHRONOUS AIRCRAFT BY ON-ORBIT DEBRIS

Robert C. Reynolds, Norman H. Fischer, and Lisa A. Miller *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm. Meeting Oct. 1980 p 71-93 (For primary document see N81-16616 07-45)

Avail: Chemical Propulsion Information Agency CSCL 13B

An analysis of the hazard presented to spacecraft involved in Sun synchronous missions is presented. Hazard levels from the natural meteoroid environment, from man made debris already in orbit, and from the explosion of orbiting stages are calculated. The effect of correlated debris motion is discussed with emphasis on the problem of second generation debris payload collisions. Author

N81-16623# Institute on Man and Science, Rensselaerville, N. Y.

A STUDY OF POTENTIAL INADVERTENT WEATHER MODIFICATION RESULTING FROM SPACE SHUTTLE SOLID ROCKET EXHAUST CLOUDS

Eugene Bollay, Lance Bosart, James Jiusto, G. Garland Lala, Volker Mohnen, and Vincent Schaefer *In* NASA. Washington The 1980 JANNAF Safety and Environ. Protect. Subcomm.

Meeting Oct. 1980 p 95-121 (For primary document see N81-16616 07-45)
Avail: Chemical Propulsion Information Agency CSCL 13B

Measured concentrations of ice nuclei in the exhaust clouds and their relatively short duration above background levels indicate that the potential for long term weather modification by space shuttle launches is not considered critical. However, localized cloud seeding effects could occur, such that rocket launches are not recommended when deep convective clouds are overhead or nearby. Local showers might be induced if supercooled clouds reached temperature levels of approximately -12 C and cooler. E.D.K.

N81-16624*# National Aeronautics and Space Administration, Washington, D. C.
ENVIRONMENTAL IMPACT STATEMENT FOR THE SPACE SHUTTLE PROGRAM Final Report
Myron S. Malkin Apr. 1978 296 p refs Revised
(NASA-TM-82278) Avail: NTIS HC A13/MF A01 CSCL 13B

Test firings and launches will release air pollutants causing a temporary localized small degradation in air quality near the tests or launch site. Areas adjacent to the site will also be subjected to moderate sound levels of predominantly low frequencies for short durations. During the launch phase, hydrogen chloride will be introduced into the stratosphere causing a small decrease in ozone. Temporary perturbations to the ionosphere will occur during orbital maneuvers and entry will have no significant effect on communication or radio wave propagation. As the Orbiter descends, a low magnitude sonic beam will be produced along the groundtrack with maximum overpressures occurring near the landing site. The overpressures will be infrequent, will vary in location and are of sufficiently low energy to be considered a momentary annoyance, if noticed at all. Major alternatives considered are discontinuation or postponement of the program, use of alternate propellants and neutralization of the ground cloud. Author

N81-16625*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
LABORATORY MEASUREMENTS OF SELECTED OPTICAL, PHYSICAL, CHEMICAL, AND REMOTE-SENSING PROPERTIES OF FIVE WATER MIXTURES CONTAINING CALVERT CLAY AND A NONFLUORESCING DYE
J. W. Usry, C. H. Whitlock, L. R. Poole, and W. G. Witte, Jr. Jan. 1981 42 p refs
(NASA-TM-81896) Avail: NTIS HC A03/MF A01 CSCL 13B

Total suspended solids concentrations ranged from 6.1 ppm to 24.3 ppm and sizes ranged between 1.5 micrometers and 10 micrometers with the most frequently occurring size less than 2 micrometers. Iron concentration was less than 1 percent of the total suspended solids. Nonfluorescing dye concentrations of the two mixtures were 20 ppm and 40 ppm. Attenuation coefficient for the five mixtures ranged from 4.8/m to 21.3/m. Variations in volume scattering function with phase angle were typical. Variations in attenuation and absorption coefficient with wavelength were similar for the mixtures without the dye. Attenuation coefficient of the mixtures with the dye increased for wavelengths less than 600 nm due to the dye's strong absorption peak near 500 nm. Reflectance increased as the concentration of Calvert clay increased and peaked near 600 nm. The nonfluorescent dye decreased the magnitude of the peak, but had practically no effect on the variation for wavelengths greater than 640 nm. At wavelengths less than 600 nm, the spectral variations of the mixtures with the dye were significantly different from those mixtures without the dye. T.M.

N81-16626# Committee on Energy and Natural Resources (U.S. Senate).
EFFECTS OF CARBON DIOXIDE BUILDUP IN THE ATMOSPHERE
Washington GPO 1980 344 p Hearing before the Comm. on Energy and Nat. Resources, 96th Congr., 2nd Sess., 3 Apr. 1980
(GPO-62-841; Publ-96-107) Avail: Committee on Energy and Natural Resources

The extent to which the burning of fossil fuels contributes to the greenhouse effect is examined as well as other sources of carbon dioxide in the atmosphere and the effects on climate, environment and society. Physical processes important for climate and climate modeling and the validity of the models is assessed. Particular attention is given to atmospheric warming and the snow-ice effects. The need for international efforts to consider the global effects of carbon dioxide and the possibilities for avoiding or reducing them is expressed. A.R.H.

N81-16627# Federal Aviation Agency, Washington, D.C. Office of Environment and Energy.
THE NEED FOR AIRPORT NOISE MONITORING SYSTEMS. THEIR USES, AND VALUE IN PROMOTING CIVIL AVIATION Final Report
J. Steven Newman Sep. 1980 41 p refs
(AD-A092240; FAA-EE-80-40) Avail: NTIS HC A03/MF A01 CSCL 05/1

The need for airport noise monitoring systems is addressed from a variety of perspectives focusing on potential benefits to airport proprietors, the airlines, noise impacted airport communities, and civil aviation in general. The operation and cost of typical noise monitoring systems is discussed. Various techniques for noise data presentation are also reviewed. The uses of radar tracking data in providing aircraft identification, position and ground track information is explored. Legal requirements for monitoring are specified and airport use restrictions are discussed. A list of U.S. and foreign airports with noise monitoring systems is presented. FAA research efforts pertaining to airport noise monitoring systems are also outlined. GRA

N81-16628# Argonne National Lab., Ill. Energy and Environmental Systems Div.
IMPACT OF AIRCRAFT EMISSIONS ON AIR QUALITY IN THE VICINITY OF AIRPORTS. VOLUME 1: RECENT AIRPORT MEASUREMENT PROGRAMS, DATA ANALYSES, AND SUBMODEL DEVELOPMENT Final Report, Jan. 1978 - Jul. 1980
R. J. Yamartino, D. G. Smith, S. A. Bremer, D. Heinold, D. Lamich, and B. Taylor Jul. 1980 168 p refs
(Contract DOT-FA77WAI-736)
(AD-A089962; FAA-EE-80-09A) Avail: NTIS HC A08/MF A01 CSCL 01/5

This report documents the results of the Federal Aviation Administration (FAA)/Environmental Protection Agency (EPA) air quality study which has been conducted to assess the impact of aircraft emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx) in the vicinity of airports. This assessment includes the results of recent modeling and monitoring efforts at Washington National (DCA), Los Angeles International (LAX), Dulles International (IAD), and Lakeland, Florida airports and an updated modeling of aircraft generated pollution at LAX, John F. Kennedy (JFK) and Chicago O'Hare (ORD) airports. The Airport Vicinity Air Pollution (AVAP) model which was designed for use at civil airports was used in this assessment. In addition the results of the application of the military version of the AVAP model and the Air Quality Assessment Model (AQAM), are summarized. GRA

N81-16629# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A GUIDANCE DOCUMENT ON AIRPORT NOISE CONTROL Final Report
Andrew S. Harris, Robert L. Miller, and Joan M. Mahoney Aug. 1980 173 p
(Contract DOT-FA78WA-4105)
(AD-A092228; BBN-10667-10676; FAA-EE-80-37) Avail: NTIS HC A08/MF A01 CSCL 01/5

This guidance document contains a general discussion of noise and noise control. Also given are sections on how humans respond to noise, noise control planning, noise descriptors that are used in the FAA's Integrated Noise MOdel, airport noise contours and land use planning, and citizen involvement in noise control planning. This document describes noise control actions and their benefits and costs; it reflects the Department of Transportation/Federal Aviation Administration Airport Noise Abatement Policy of 1976, a detailed, straightforward statement of the problems of airport noise and the shared responsibilities of those who must work to control it. The Federal legislature

and administrative mandates for noise control are also reviewed. GRA

N81-16630# Oak Ridge National Lab., Tenn. Health and Safety Research Div.

A STATISTICAL ANALYSIS OF ATMOSPHERIC DISPERSION PARAMETERS FROM KARLSRUHE, FEDERAL REPUBLIC OF GERMANY: AN APPLICATION OF TEDPED

Charles W. Miller and David E. Fields 1980 15 p refs
(Contract W-7405-eng-26)
(CONF-8010106-4) Avail: NTIS HC A02/MF A01

The model often used to estimate atmospheric concentrations of pollutants is the Gaussian plume model. Two critical parameters in this model are the crosswind and vertical standard deviations of the concentrations in the plume, sigma sub y and sigma sub z, respectively. The computer program TEDPED was used to perform a statistical analysis of a limited number of values of sigma sub y and sigma sub z based on air concentration measurements. It was found that sigma sub y and sigma sub z are associated with a range of values rather than a single, unique value for each combination of atmospheric stability category and downwind distance considered. The ratio of the high to low value of this range was most often near 2, but in a limited number of cases it was 10 or higher. These results have direct implications for estimates of the uncertainty associated with predictions of the impact on man of various pollutants released to the atmosphere. T.M.

N81-16631# Brookhaven National Lab., Upton, N. Y. Process Sciences Div.

THE VALUE OF FORESTATION IN ABSORBING CARBON DIOXIDE SURROUNDING A COAL FIRED POWER PLANT

V. D. Dang and M. Steinberg Aug. 1980 25 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51279) Avail: NTIS HC A02/MF A01

The dispersion of carbon dioxide emitted from a 1000 MW(e) coal fired power plant is investigated. Forestation is examined as a means for removal and control of atmospheric carbon dioxide at a distance of 5 to 10 km away from the power plant stack. An equilibrium and a dynamic approach are considered. For an average temperate zone forest growth rate (7.42 mg/sqdm hr), the overall reduction in forested land area required to remove the equivalent of all of the CO2 from a 1000 MW(e) power plant would be less than 3.3% compared to removing the equivalent amount of CO2 by planting forests remotely from the plant. If faster growing tropical plants or trees having up to four times the temperature plant growth rate were used, there would be a maximum savings of 15% in forested land area compared to a remote planting. This magnitude of reduction in cultivated forest area is insufficient to recommend planting forested areas adjacent to central power stations as a means of controlling CO2 emission. Rather it is suggested to provide sufficient increased regional forest areas on a global scale. M.G.

N81-16632# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

ORGANIC CARBON AND NITROGEN IN THE SURFACE SEDIMENTS OF WORLD OCEANS AND SEAS: DISTRIBUTION AND RELATIONSHIP TO BOTTOM TOPOGRAPHY

Eugene T. Premuzic Jun. 1980 218 p refs
(Contract EY-76-C-02-0016)
(BNL-51084) Avail: NTIS HC A10/MF A01

Information dealing with the distribution of organic carbon and nitrogen in the top sediments of world oceans and seas was gathered and evaluated. Based on the available information a master chart was constructed which shows world distribution of sedimentary organic matter in the oceans and seas. Since organic matter exerts an influence upon the settling properties of fine inorganic particles, e.g., clay minerals and further, the interaction between organic matter and clay minerals is maximal, a relationship between the overall bottom topography and the distribution of clay minerals and organic matter should be observable on a worldwide basis. Initial analysis of the available data indicates that such a relationship does exist and its significance is discussed. Author

N81-16633# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Labs.

ATMOSPHERIC TRACER EXPERIMENTS FOR REGIONAL DISPERSION STUDIES

J. L. Heffter, G. J. Ferber, and P. W. Krey (DOE, New York) 1980 17 p refs Presented at the European Seminar on Radioactive Releases and their Dispersion in the Atmosphere Following a Hypothetical Reactor Accident, Riso, Italy, 22-25 Apr. 1980
(CONF-8004121-1; Paper-46) Avail: NTIS HC A02/MF A01

Tracer experiments are being conducted to verify atmospheric transport and dispersion calculations at distances from tens to hundreds of km from pollutant sources. In one study, a two and one half year sampling program was carried out at 13 sites located 30 to 140 km from a source of Kr(85) at the Savannah River Plant in South Carolina. Average weekly concentrations as well as twice daily concentrations were obtained. Sampling data and meteorological data, including surface, tower and rawinsonde observations are available on magnetic tape for model verification studies. Some verification results for the air resources laboratories atmospheric transport and dispersion mode are shown for averaging periods from one week to two years. Author

N81-16634# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.

STATUS OF OTEC ENVIRONMENTAL MONITORING PROGRAM

P. Wilde Jun. 1980 10 p refs
(Contract W-7405-eng-48)
(LBL-10887) Avail: NTIS HC A02/MF A01

Oceanographic studies in support of assessment and technical operations for Ocean Thermal Energy Conversion were conducted in the South Atlantic Plant ship region and at benchmark sites off Puerto Rico, the Gulf of Mexico and off Hawaii. Data was obtained from current meter arrays, hydrocasts, and net tows using the same type of equipment, sample depths, sample frequencies, techniques and analyses to provide a uniform basis of comparison among the sites. In addition, particulate, trace metal, and radiologic studies off St. Croix, Virgin Islands and primary production bioassay experiments off Hawaii were performed to validate methods. Physical models were developed to test potential ecologic models for use in pilot assessments. Marine geologic/oceanographic base maps and data compilation sheets were prepared for the Hawaiian and Puerto Rico Virgin Island regions. S.F.

N81-16635# California Univ., Livermore. Lawrence Livermore Lab.

ECOLOGY PROBLEMS ASSOCIATED WITH GEOTHERMAL DEVELOPMENT IN CALIFORNIA

J. H. Shinn and R. R. Ireland 4 Aug. 1980 14 p refs Submitted for publication Sponsored by DOE
(UCRL-83941-Rev-1; CONF-800867-1-Rev-1) Avail: NTIS HC A02/MF A01

Geothermal power plants have the potential for supplying about 5 percent of the U.S. electrical generating needs by 1985 and are even now supplying about one third of San Francisco's electricity. Our investigations have shown that the typical geothermal field, such as the hot water resource of Imperial Valley, can be developed in an environmentally sound manner when proper considerations are made for ecosystem problems. Experimental evidence is presented, both pro and con for potential impacts due to habitat disturbance, powerline corridors, noise effects, trace element emissions from cooling towers, accidental brine discharges into aquatic or soil systems, competition for water and H2S effects on vegetation. A mitigation and control strategy is recommended for each ecological issue and it is shown where effects are likely to be irreversible. E.D.K.

N81-16636# SRI International Corp., Menlo Park, Calif.

STUDY OF THE ADEQUACY OF AIR MONITORING Final Report

Eugene Shelar, Jr. and Ronald E. Ruff Sep. 1980 350 p refs Sponsored by National Commission on Air Quality
(PB81-109183; AQ-7405-8D) Avail: NTIS HC A15/MF A01 CSCL 13B

The adequacy of air quality monitoring data and sampling procedures was evaluated by assessing the content and

implementation of EPA's May, 1979 air monitoring and quality assurance regulations. Interviews were conducted in five areas (Portland, Kansas City, New Orleans-Baton Rouge, Jacksonville and Boston) with governmental, industry and public interest groups. It was concluded that, given proper personnel and funding, the regulations will provide by 1983 a national monitoring system to satisfy the needs of future air quality planning and status attainment. GRA

N81-16637# Dallas Dept. of Water Utilities, Tex.
ULTRAVIOLET DISINFECTION OF MUNICIPAL WASTEWATER EFFLUENTS Final Report, Jun. 1974 - Aug. 1976
Albert C. Petrasek, Jr., Harold W. Wolf, Steven E. Esmond, and D. Craig Andrews Aug. 1980 283 p refs Prepared in cooperation with Texas A and M Univ., College Station
(Grant EPA-R-803292)
(PB81-111049; EPA-600/2-80-102) Avail: NTIS HC A13/MF A01 CSCL 13B

Two different UV exposure and irradiation systems were studied. The first system investigated was the Kelly-Purdy Unit, which consisted of a shallow-tray exposure chamber with 13 UV lamps mounted horizontally 10 cm above the bottom of the chamber. This unit was operated under varying conditions of both flow and depth and generally provided inadequate disinfection, although fecal coliform densities were usually reduced by approximately three logs. The second UV system used was the Model EP-50 manufactured by Ultraviolet Purification Systems, Inc. This exposure chamber consisted of a stainless steel pressure vessel with nine UV lamps running longitudinally through the chamber. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N81-16638 Minnesota Univ., Minneapolis.
A LABORATORY STUDY OF THE MAGNETIC PROPERTIES OF SYNTHETIC TITANOMAGHEMITES: IMPLICATIONS FOR THE MAGNETIC PROPERTIES OF OCEAN BASALTS Ph.D. Thesis
Bruce Matthew Moskowitz 1980 191 p
Avail: Univ. Microfilms Order No. 8102133

An investigation of the magnetic properties of: (1) synthetic titanomaghemites with composition X = .6 and (2) oceanic basalts from DSDP site 417D is presented. The main objective of this study was to determine the variation of viscous remanent magnetization (VRM) with low temperature oxidation (z). The results of the VRM studies on the basalts from site 417D indicate that activation of small sections of domain walls may be responsible for the VRM in the massive flows, giving way to activation of larger sections or entire domain walls as grain size decreases. The predominant influence controlling VRM at site 417D is grain size and not oxidation. The effects of a diffusive magnetic after effect were also observed in these basalts. It is shown that a theoretical approach for determining domain transitions in magnetite and titanomaghemite is possible. The magnetite calculations show that for parallelepiped-shaped grains, the canonical case of a PSD grain or psark can be a major contributor to remanence in rocks containing magnetite. The calculations also predict that domain transitions increase with z for titanomaghemites and qualitatively explains some of the observed trends in magnetic properties of oceanic basalts. The model predicts that psarks may be the major contributors to remanence in oxidized pillow basalts. Dissert. Abstr.

N81-16639 California Univ., Berkeley.
HIGH-PRECISION TRAVEL-TIME MONITORING WITH SEISMIC REFLECTION TECHNIQUES Ph.D. Thesis
Richard Wayne Clymer 1980 200 p
Avail: Univ. Microfilms Order No. 8029362

The feasibility of using controlled-source reflection and refraction methods for travel-time monitoring is discussed. Travel-time changes, if any, that may be detectable with such measurement techniques are described. Travel-times were measured at sites in two areas south of Hollister, California, along the creeping zone of the San Andreas fault using a single-channel system with real-time on-site data processing. Events at 7 to 8 sec travel-time were monitored at sites about 7 km from the San Andreas fault in Bickmore Canyon in both short-term experiments spanning a number of hours and in a long-term series of measurements spanning two years. Two major types of noise were identified. Scattering of the short-term data, believed to be due to source variations, limits the measurement precision to about 0.01 percent of the travel-time for the deep reflections and about 0.1 percent for the first arrivals. Secondly, the dominant features of the long-term data sets are persistent, rainfall-related, seasonal oscillations in travel-time (of as much as 15 to 20 msec peak-to-peak), wavelet amplitude and waveform. Dissert. Abstr.

N81-16640 California Univ., San Diego.
LINEAR INVERSION OF BODY WAVE DATA Ph.D. Thesis
Randall Scott Jacobson 1980 104 p
Avail: Univ. Microfilms Order No. 8100028

A seismic refraction profile was conducted in the central Bay of Bengal over a thick (> 5 km) homogeneous turbidite section. Attenuation was measured as a function of depth. The standard refraction profile was altered somewhat in order to receive arrivals of refracted energy uncontaminated by energy which propagates strictly along water-borne paths. Use of digitally recording sea floor hydrophone systems as receivers and large charges detonated by pressure-sensitive depth charges eliminated most of the effects of 3 km of water. This data was also used to ascertain the velocity depth function. A wide angle reflection/refraction profile using a near-surface source and recorded by a moored surface buoy was used to augment the data employed to determine the velocity function. Dissert. Abstr.

N81-16641 Oklahoma Univ., Norman.
APPLICATION OF COMPUTER TO LITHOSTRATIGRAPHIC CORRELATION AND THREE-DIMENSIONAL CONFIGURATION Ph.D. Thesis
M. Mummtaz Najjar-Bawab 1980 236 p
Avail: Univ. Microfilms Order No. 8101519

The method of constructing the subsurface structure in two and three dimensions consists of four procedures. First, digitize the original logs and establish stratigraphic units by automatically or manually segmenting each individual well log. Secondly, cross-correlate four well logs at a time by spectral analysis to determine the lateral continuity, variation of bed thickness and depth of stratigraphic unit at each well. Thirdly, initiate a structure map based on data from the previous procedure. Finally, project the structure map down between the computer correlated wells that produces the two dimensional cross-sections and the three dimensional configuration of the stratigraphic unit. The computer model BASEL developed in this research was tested by investigating the configuration of the Lower Earlsboro Sand unit in the St. Louis Oil Field, Oklahoma, using resistivity logs. It was further tested by evaluating the configuration of coal beds in the Knife River Basin, North Dakota, using gamma logs. Dissert. Abstr.

N81-16642*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
TIME DEPENDENT DEFORMATION AND STRESS IN THE LITHOSPHERE Ph.D. Thesis
Mai Yang Dec. 1980 291 p refs
(Grant NAG5-41)
(NASA-CR-163869) Avail: NTIS HC A13/MF A01 CSCL 08G

Efficient computer programs incorporating frontal solution and time stepping procedure were developed for the modelling of geodynamic problems. This scheme allows for investigating the quasi static phenomena including the effects of the rheological structure of a tectonically active region. From three dimensional models of strike slip earthquakes, it was found that lateral variation of viscosity affects the characteristics of surface deformations. The vertical deformation is especially informative about the viscosity structure in a strike slip fault zone. A three dimensional viscoelastic model of a thrust earthquake indicated that the transient disturbance on plate velocity due to a great plate

boundary earthquake is significant at intermediate distances, but becomes barely measurable 1000 km away from the source.
T.M.

N81-16643*# California State Univ., Northridge. Big Bear Solar Observatory.
REVERSED-POLARITY REGIONS
Frances Tang Dec. 1980 24 p refs
(Grant NAGw-27)
(NASA-CR-163913; BBSO-0199) Avail: NTIS HC A02/MF A01 CSCL 08G

The 58 RPRS studied have a lifespan comparable to normal active regions and have no tendency to rotate toward a more normal alignment. They seem to have stable configurations with no apparent evidence suggesting stress due to their anomalous magnetic alignment. Magnetic complexity in RPRs is the key to flare productivity just as it is in normal regions - weak field RPRs produced no flares and regions with complex spots produced more flares than regions with noncomplex spots by a factor of 5. The RPRs however, differ from normal regions in the frequency of having complex spots, particularly the long lived complex spots, in them. Less than 17 percent of normal ARs have complex spots; less than 1.8 percent have long lived complex spots. In contrast, 41 percent of RPRs have complex spots and 24 percent have long lived complex spots.
T.M.

N81-16644*# Ocean Data Systems, Inc., Monterey, Calif.
ATMOSPHERIC ANALYSIS MODELING IN SUPPORT OF SEASAT Final Technical Report
Rodger A. Langland and Pamela L. Stephens Nov. 1978 164 p refs
(Contract NAS5-24469)
(NASA-CR-160086) Avail: NTIS HC A08/MF A01 CSCL 04A

Atmospheric objective analysis models were developed and tested in preparation for assessing the utility of Seasat data. Of the several discretionary procedures in such computer programs, the effects of three were examined and documented: (1) the effect of varying the weights in the pattern conserving techniques; (2) the effect of varying the data influence region; (3) the effect of including wind information in analysis of mass-structure variables. The problem of inserting bogus reports is also examined.
E.D.K.

N81-16645*# Systems and Applied Sciences Corp., Riverdale, Md.
GRAVITATIONAL FIELD MODELS FOR STUDY OF EARTH MANTLE DYNAMICS Final Report
10 Aug. 1979 12 p refs
(Contract NAS5-25141)
(NASA-CR-160083; NO-R-SAP-8-79-01) Avail: NTIS HC A02/MF A01 CSCL 08G

The tectonic forces or stresses due to the small scale mantle flow under the South American plate are detected and determined by utilizing the harmonics of the geopotential field model. The high degree harmonics are assumed to describe the small scale mantle convection patterns. The input data used in the derivation of this model is made up of 840,000 optical, electronic, and laser observations and 1,656 5 deg x 5 deg mean free air anomalies. Although there remain some statistically questionable aspects of the high degree harmonics, it seems appropriate now to explore their implications for the tectonic forces or stress field under the crust.
E.D.K.

N81-16646# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
COOPERATIVE EFFECTS IN LIGHT SCATTERING FROM AEROSOL CLUSTERS AND SURFACE ASSEMBLIES Final Report, Aug. 1979 - Jan. 1980
Richard A. Farrell, Robert H. Andreo, and Jerry A. Krill Aberdeen Proving Ground, Md. Army Armament Research and Development Command Jun. 1980 35 p refs
(Contract N00024-78-C-5384)
(AD-A092378; AD-E410335; APL/JHU/RAD-7718-01; ARCSL-CR-80046) Avail: NTIS HC A03/MF A01 CSCL 04/1

Vector stochastic variational principles are derived for electromagnetic plane wave scattering from perfectly conducting objects and rough surfaces and from conducting dielectrics which are generally inhomogeneous and anisotropic. The parameters describing the scatterers may be deterministic or random with completely arbitrary statistics. Specifically, the stochastic vector principle for conducting dielectrics is extended to include anisotropic materials with no symmetry restrictions on the conductivity and permittivity tensors. In addition, a stochastic variational principle is derived for polarized plane wave scattering from a randomly rough planar surface which is perfectly conducting. This formulation incorporates a half-space dyadic Green function. Finally, a variational principle for closed, perfectly conducting scatterers is recast into stochastic form. These variational principles are for the statistical moments and probability density functions of T and the absolute value of T squared, where T is the component of the normalized far-field vector scattering amplitude vector T along with an arbitrary polarization direction E sub s.
Author

N81-16647# Naval Research Lab., Washington, D. C. Telecommunications Systems Technology Branch.
SPATIAL COHERENCE MEASUREMENTS AND EVALUATION OF A NOISE REDUCTION TECHNIQUE FOR AMBIENT NOISE FROM 0.3 TO 40 Hz
R. J. Dinger and J. A. Goldstein 15 Oct. 1980 60 p refs
(RR0210141)
(AD-A092151; NRL-8430) Avail: NTIS HC A04/MF A01 CSCL 08/14

Measurements of the ambient magnetic field in the frequency range from 0.3 Hz to 40 Hz were made at a midlatitude location in winter (China Lake, California) and an auroral location in summer (Tromso, Norway). At each location two sensitive triaxial SQUID magnetometers were installed at sites whose separation was varied from 0.5 km to 15 km (in California) and from 0.5 km to 9.3 km (in Norway). Approximately two weeks of nearly continuous data were recorded at each location. Schumann resonances with a particularly high ratio of signal to instrument noise were observed with six orders of the resonances typically visible. Peaks attributed to wind induced motion noise were observed in the spectra, particularly at the exposed China Lake sites.
T.M.

N81-16648# Naval Postgraduate School, Monterey, Calif.
LOW FREQUENCY GEOMAGNETIC FLUCTUATIONS (.04 TO 25 Hz) ON LAND AND ON THE FLOOR OF MONTEREY BAY M.S. Thesis
Gerald R. McDevitt and B. Bert Homan Jun. 1980 112 p refs
(AD-A092399) Avail: NTIS HC A06/MF A01 CSCL 08/14

A coil antenna consisting of approximately 6000 turns of copper wire was used to measure the horizontal component of fluctuations of the Earth's magnetic field on the floor of Monterey Bay in water depth of approximately 50 meters. The results indicate that the power spectral density of the fluctuations varies from 10(nT)-sq/Hz at 0.04 Hz to 0.000001(nT)-sq/Hz at 25 Hz, a monotonic decrease of about 6 dB/octave, except in the 8-20 Hz region where the Schuman resonances occur. While the sensitivity of the equipment was insufficient to measure the vertical component of the fluctuation we can put an upper limit of 0.001(nT)-sq/Hz at 1 Hz and 0.000001(nT)-sq/Hz) at 10 Hz on the magnitude of this component. The same sensor was also used to measure various components of the field fluctuations at a remote land site (Chew's Ridge). In the frequency range observed the general shape of the spectra was similar to those obtained at sea. However, a strong azimuthal variation at certain frequencies was noted in the land data. The possibility that these directional signals are of man made origin cannot be excluded at this time.
GRA

N81-16649# Naval Research Lab., Washington, D. C. Optical Radiation Branch.
ATMOSPHERIC TRANSMISSION MEASUREMENTS AT WHITE SANDS MISSILE RANGE, AUGUST 1978 Interim Report
S. T. Hanley, J. A. Dowling, R. F. Horton, J. A. Curcio, C. O. Gott, M. A. Woytko, and J. Storvick 29 Oct. 1980 71 p refs
(AD-A092445; NRL-8422) Avail: NTIS HC A04/MF A01 CSCL 04/2

High-resolution atmospheric transmission measurements have been made at White Sands Missile Range, New Mexico. Wavelengths measured include 0.63 micron, 1.06 micron, 3-5 micron, and 8-14 micron. Meteorological variables including air temperature, dewpoint, wind speed and direction, solar radiation, and the atmospheric temperature structure parameter CT were monitored during transmission measurements, at the endpoints of the propagation path. Stronger continuum absorptions at DF laser frequencies than expected and limiting effects of high winds and atmospheric turbulence were observed. GRA

N81-16650# Air Force Geophysics Lab., Hanscom AFB, Mass. Aeronomy Div.

STRUCTURE AND COMPOSITION MEASUREMENTS IN EQUATORIAL IONOSPHERIC BUBBLES Final Report

R. Narcisi, E. Trzcinski, G. Frederico, L. Wlodyka, and P. Bench 9 Jul. 1980 27 p refs Sponsored in part by Defense Nuclear Agency

(AF Proj. 2310)

(AD-A092448; AFGL-TR-80-0222; AFGL-ERP-711) Avail: NTIS HC A03/MF A01 CSCL 07/4

Two multiinstrument Terrier Malemute rockets including ion mass spectrometers were launched during equatorial spread F events. Detailed ionospheric structure and composition measurements were made between about 100 and 530 km. From the composition signatures, the source of the bubbles appeared to be near the F region ledge. Results indicate that neutral atmospheric turbulence is not a major source of ionospheric irregularities. Time periods for ion chemical processes to achieve the observed composition are discussed in terms of bubble formation times and rise velocities. T.M.

N81-16651# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Meteorology.

DYNAMIC INTERACTIONS BETWEEN THE TROPOSPHERE AND STRATOSPHERE Ph.D. Thesis - Utah Univ.

James Paul Koermer 1980 200 p refs

(AD-A092420; AFIT-CI-80-31D) Avail: NTIS HC A09/MF A01 CSCL 04/2

A primitive equation spectral model using spherical harmonics is formulated to study interactions between the troposphere and stratosphere in association with sudden stratospheric warmings. In order to follow vertical wave propagation so important to this process, the model consists of 31 levels with 5 in the troposphere and the other 26 in the stratosphere and mesosphere. Using sigma coordinates for the former and log-pressure coordinates for the latter, separate equations for each system are combined to form a single matrix governing equations. The gradual introduction of planetry scale topography to an initially balanced state representative of observed mean winter conditions in the Northern Hemisphere is used to force changes in the initial field during 40 day time integrations. Utilizing the same initial tropospheric conditions, three cases were run. The first case started with a weak polar night jet in the stratosphere and mesosphere. The second case had a much stronger polar vortex. For the third case, a lid was placed on the troposphere and no interaction was allowed with the atmosphere at higher levels. Results of these integrations indicate that realistic stratospheric warmings can be simulated by simple orographic forcing. GRA

N81-16652# Aerodyne Research, Inc., Bedford, Mass. Center for Electro-Optical Signature Studies.

ADDITION OF A 5/CM SPECTRAL RESOLUTION BAND MODEL OPTION TO LOWTRAN5 Final Technical Report

David C. Robertson, Lawrence S. Bernstein, and Robert Haimes Oct. 1980 225 p refs

(Contract N60530-80-C-0087; ZF32392002)

(AD-A091972; ARI-RR-232) Avail: NTIS HC A10/MF A01 CSCL 04/1

The modified version of the atmospheric transmission and radiation code included: an increase in the spectral resolution from 20 to 5/cm; the addition of temperature dependent molecular absorption coefficients; and the use of a multiparameter, Doppler-Lorentz band model for calculation of molecular transmittance. A set of 5/cm band model parameters were developed using the molecular data in the Air Force Geophysics Lab HITRAN line compilation for the major atmospheric absorbers. Comparisons of LOWTRAN5 transmittance and radiation calculations with the modified version, LOWTRAN5 (BMOD), are shown and discussed. T.M.

N81-16653# Battelle Columbus Labs., Ohio. PJ304292

COMPARISON OF ELECTRON DENSITIES IN THE MIDDLE ATMOSPHERE INDICATED BY ROCKET BORNE PROBING TECHNIQUES Final Report

Thomas M. York Aug. 1980 44 p refs Prepared in cooperation with Pennsylvania State Univ., University Park

(Contract DAAG29-76-D-0100; DA Proj. 1L1-61102-B-53A)

(AD-A092503; ERADCOM/ASL-CR-80-0100-2) Avail: NTIS HC A03/MF A01 CSCL 04/1

Indications of electron density in the middle atmosphere (40-90 km) have been calculated from several different rocket-borne probes, and intercomparisons of these values have been made. Blunt probe data have been analyzed to determine electron densities directly from values of current at positive bias saturation voltages. Saturation currents from subsonic blunt probes are favorably compared with those from supersonic nose tip probes. Supersonic saturation currents have been analyzed to predict electron densities without any calibration from other diagnostics. The effects of shock waves or shock compressions have been discussed and included in electron density computations. The related influence of electron attachment on electron density determinations has been evaluated, and it appears that rates higher than those presently accepted are compatible with data. Outgas of water vapor from rocket and probe materials is described, and the amount of outgas near the surface of a probe is evaluated. The influence of water vapor on impedance probe measurements is evaluated for a limiting condition, and in that case is found to be significant. Comparison of electron density data on one day during the 1979 Canada-US Solar Eclipse Program is made, but close agreement is not evident. This is partially due to the dynamic conditions during the data gathering. GRA

N81-16654# SRI International Corp., Menlo Park, Calif.

BACKSCATTER MEASUREMENTS OF 11-CM EQUATORIAL SPREAD-F IRREGULARITIES Topical Report, 1 Oct. - 1 Nov. 1979

Roland T. Tsunoda 1 Jun. 1980 26 p refs

(Contract DNA001-79-C-0153)

(AD-A091980; DNA-5324T; Topical-5) Avail: NTIS HC A03/MF A01 CSCL 04/1

Observations of radar backscatter from field aligned irregularities (FAI) are described. These measurements extend the spatial wavelength regime of F region FAI to lengths that approach both the electron gyroradius and the Debye length. Agreement of these results with the theory of high frequency drift waves suggest that these observations may be unique to the equatorial ionosphere. That is, the requirement for low electron densities that the theory calls for may preclude the existence of 11 cm FAI elsewhere in the F region ionosphere, except in equatorial plasma bubbles. T.M.

N81-16655# Science Applications, Inc., La Jolla, Calif.

SATELLITE MEASUREMENTS OF ATMOSPHERIC AEROSOLS Annual Report, 1 Apr. 1979 - 14 Nov. 1980

M. Griggs 14 Nov. 1980 27 p refs

(Contract N00124-77-C-0489)

(AD-A092152; SAI-131-80-603-LJ) Avail: NTIS HC A03/MF A01 CSCL 17/8

Ground truth measurements of the atmospheric aerosol optical thickness and radiance data for the GOES 1 and SMS 2 satellites, show that the satellite sensors were stable over a period of eighteen months, and that there is probably a difference in the radiometric calibrations of the sensors. Theoretical calculations show that errors, due to variations in the aerosol properties, in inferring the aerosol content from a satellite radiance measurement are similar for the nadir viewing sensors (e.g., LANDSAT MSS) and for the scanning sensors (e.g., NOAA-6 AVHRR). GRA

N81-16656# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

SLANT VISUAL RANGE FROM DROP-SIZE DISTRIBUTION M.S. Thesis - Texas A and M Univ.

Edwin Stanley Arrance Aug. 1980 95 p refs

(AD-A092364; AFIT-CI-80-17T) Avail: NTIS HC A05/MF A01 CSCL 01/2

This research investigated the feasibility of obtaining visual range and slant visual range by use of drop-size distribution. The results of Davies' equation for computing visibility from drop-size distribution were compared to known values and those obtained from Mie scattering theory based on a program developed by Kattawar and Plass. Next, Davies' equation was applied to a Marshall-Palmer drop-size distribution and a vertically varying distribution obtained from a program developed by Borchers. The Marshall-Palmer distribution and visibility agree with those from Borchers' work. Davies' method of obtaining visibility then was used successfully to compute slant visual range along a glideslope. The drop-size distribution at various levels along the glideslope was produced by Borchers' program. GRA

N81-16657# Dayton Univ., Ohio. Research Inst.

ATMOSPHERIC TRANSMISSION AND PARTICLE SIZE MEASUREMENTS, PROCEEDINGS OF WORKSHOP Final Report, Jul. 1979 - May 1980

John F. Myers, ed., James K. Luers, and William C. Smith May 1980 220 p refs Conf. held in Dayton, Ohio, 23-25 Oct. 1979

(Contract F33615-79-C-1894)

(AD-A092579; UDR-TR-80-51; AFWAL-TR-80-1086) Avail: NTIS HC A10/MF A01 CSCL 04/1

A highly accurate description of the atmosphere in terms of its transmission and aerosol size distribution is needed to quantify the performance of various DOD reconnaissance and weapons targeting systems. Recent DOD measurement programs have produced inconsistent data sets. Doubt has been cast upon the accuracies and sensitivities of current meteorological instruments which provide transmission and particle size data. The purpose of the Atmospheric Transmission and Particle Size Measurements workshop was to provide a forum for information exchange between people who have been involved in the measurements. A definition of the state of the art of present equipment and technique was obtained. An overall summary, workshop session summaries, and abstracts of presentations are included. GRA

N81-16658# University Coll., London (England). Dept. of Physics and Astronomy.

TROPOSPHERIC - STRATOSPHERIC TIDAL INVESTIGATIONS. HOUGH COMPONENTS OF OZONE HEATING Interim Scientific Report, 1 Dec. 1976 - 30 Apr. 1980

Gerald V. Groves 30 Jun. 1980 49 p refs Prepared in part for European Office of Aerospace Research and Development, London

(Grant AF-AFOSR-3224-77; AF Proj. 6687)

(AD-A092631; AFGL-TR-80-0351; SR-4) Avail: NTIS HC A03/MF A03 CSCL 04/1

Formulae are derived for the Hough components and the mean rate of solar radiational heating by ozone absorption in the presence of a lower reflecting layer. A model of ozone densities based on observational data is presented for each of the four seasonal months January, April, July and October at heights 0(5)80 km and latitudes 0(15)90 deg. Diurnal and semidiurnal components of heating are evaluated for migrating modes and discussed in relation to features of the adopted ozone model. Comparisons are made with earlier evaluations. GRA

N81-16659# University Coll., London (England).

OZONE AND WIND VARIATIONS IN THE STRATOSPHERE AND MESOSPHERE Scientific Report, 1 Dec. 1976 - 31 Oct. 1978

Gerald V. Groves 31 Dec. 1978 72 p refs Sponsored in part by European Office of Aerospace Research and Development

(Grant AF-AFOSR-3224-77; AF Proj. 6687)

(AD-A092629; AFGL-TR-80-0349; SR-2) Avail: NTIS HC A04/MF A01 CSCL 04/1

A latitudinal and seasonal model for ozone concentrations to 75 km is presented. At the lower altitudes the model is based on Umkehr data from the world ozone network and at the higher altitudes on rocket and satellite data as well as some ground-based measurements. The model is tabulated for the four seasons and latitudes 0 deg to 60 deg N in steps of 15 deg for each 5 km height interval from 10 to 75 km. Seasonal wind variations in the mesophere are reviewed and a mean meridional circulation is inferred for the winter hemisphere. Diurnal and semidiurnal wind oscillations at heights between 25 and 60 km are presented being the results of a comprehensive analysis of data from short series of rocket launchings held at Various Western Hemisphere sites between 1965 and 1974. GRA

N81-16660# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Meteorology.

AUTOREGRESSIVE MODELING OF THE LOWER STRATOSPHERIC WINDS AND TEMPERATURE FOR AN EQUATORIAL LOCATION M.S. Thesis

Kird Edel Lehneis 1980 75 p refs

(AD-A092521; AFIT-CI-80-37T) Avail: NTIS HC A04/MF A01 CSCL 04/2

The purpose of this research was to forecast monthly mean values of zonal and meridional wind components and temperature for 11 pressure levels from 100 to 10 mb for an equatorial location. Rawinsonde data for Kwajalein were used to compile 33 data series of monthly means for the three variables and the 11 pressure levels. Univariate autoregressive (AR) and multivariate autoregressive (MVAR) models were used to forecast monthly means of each variable at each pressure level for a 12-month period. In order to get a quantitative measure of the effectiveness of the AR and MVAR forecasts, root-mean-square-errors were calculated and compared with RMSEs computed for climatology 'forecasts'. GRA

N81-16661# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Atmospheric Sciences.

RELATIVISTIC ELECTRON PRECIPITATION: AN OBSERVATIONAL STUDY Ph.D. Thesis - UCLA

Leopold Joseph Andreoli 1980 322 p refs

(AD-A092545; AFIT-CI-80-26D) Avail: NTIS HC A14/MF A01 CSCL 04/1

The object of this dissertation is to analyze satellite data to investigate the morphology of strong diffusion relativistic electron precipitation (REP) events with the ultimate purpose of gaining insights into the precipitation mechanism and determining atmospheric consequences. Analysis of fourteen (14) months of magnetic electron spectrometer and proton telescope data from the Air Force S3-3 satellite from July 1976 to September 1977 is presented. A theoretical approach to the REP mechanism is presented. Finally, an investigation of the energy deposition rates from these events and their ultimate effect on the ionized and neutral atmosphere with emphasis on ozone modification is presented. GRA

N81-16662# Naval Research Lab., Washington, D. C.

SCALE SIZES AND LIFETIMES OF F REGION PLASMA CLOUD STRIATIONS AS DETERMINED BY THE CONDITION OF MARGINAL STABILITY

B. E. McDonald, S. L. Ossakow, S. T. Zalesak, and N. J. Zabusky 17 Nov. 1980 42 p refs Sponsored by the Defense Nuclear Agency

(AD-A092568; NRL-MR-4385) Avail: NTIS HC A03/MF A01 CSCL 04/1

The two dimensional integrated Pedersen conductivity model for F region plasma cloud striation development may be cast in dimensionless form. The result implies that a structure's stability against bifurcation depends upon whether a diffusion parameter R exceeds a critical value. The critical R for striations is determined by high resolution computer simulation for conductivity ratios M from 2 to 30. Our results combined with electron diffusivity of order 1 square meter/sec agree with observed minimum scale sizes of 15 meters. For turbulent diffusivity of order 100 square meter/sec, our results agree with frequent observations of kilometer-scale structures which 'freeze up' and last for times of order 10000 seconds. This lifetime is also predicted by our results. GRA

N81-16663# Atmospheric and Environmental Research, Inc., Cambridge, Mass.

MODELING OF CHEMICAL PROCESSES IN THE TROPOSPHERE AND STRATOSPHERE Final Report, 1 Aug. 1978 - 31 Oct. 1980

N. D. Sze, M. K. W. Ko, R. Specht, and M. Livshits Hanscom

AFB, Mass. AFGL Aug. 1980 153 p refs
(Contract F19628-78-C-0215; AF Proj. 6687)
(AD-A092704; AFGL-TR-80-0251) Avail: NTIS HC A08/MF A01 CSCL 04/1

This report presents major accomplishments and significant findings of research conducted during the two years of contract to the Air Force Geophysics Laboratory, ending September 1980. The overall research effort is concerned with numerical modeling of chemical and dynamical processes in the troposphere and stratosphere. It encompasses four major areas of study: coupled chemical kinetics and transport in a one dimensional diurnal model; tropospheric and stratospheric sulfur budgets; ozone perturbation studies; and the development of a two dimensional model which couples the ozone chemistry with the mean wind field and the eddy transport. GRA

N81-16664# Polytechnic Inst. of New York, Farmingdale. Microwave Research Inst.
IONOSPHERIC SCINTILLATION
David M. Wu Sep. 1980 231 p refs
(Contract N00014-76-C-0176)
(AD-A092720; POLY-MRI-1410-80) Avail: NTIS HC A11/MF A01 CSCL 04/1

A renormalization technique, employed in the spirit of the formal theory of scattering, is applied to the problem of ionospheric scintillation. Using the forward scattering approximation for wave propagation and a Markov approximation for ionospheric fluctuations, one derives renormalized moment equations descriptive of the wave statistics. The propagation of the two and four point wave statistics through the ionosphere are obtained using a slow quasiparticle distribution function S. For the case of an ionospheric structure function H(xi) = a xi(squared) where xi is a transverse distance, one can obtain exact analytical solutions for the wave statistics. For an arbitrary fluctuation spectrum, one can evaluate the S function along a quasiparticle trajectory and thereby infer second moments exactly and fourth moments approximately. Knowledge of the S function enables one to ascertain statistical properties, such as average intensity, two point intensity correlation and the scintillation index S(4). The Scintillation index for the case of a plane wave propagating through the ionosphere is studied for the case of an arbitrary power spectrum of ionospheric fluctuations. Peaks superposed on a power law spectrum are found to increase the value of S(4). A focusing effect on the S(4) vs. z variation is observed in the strong scintillation limit. An experimental power spectrum, corresponding to relative density fluctuations of about 20% as obtained from situ measurements by the Atmospheric Explorer-E satellite, is used to calculate the corresponding S(4) for night time equatorial scintillations. GRA

N81-16665# Institute for Defense Analyses, Arlington, Va.
A STUDY OF STRATOSPHERE-TO-TROPOSPHERE TRANSFER USING RADIOACTIVE TRACER DATA IN A ONE DIMENSIONAL PARAMETERIZATION Final Report
Ernest Bauer Feb. 1980 86 p refs
(Contract DOT-FA77WA-3955)
(AD-A092841; IDA-P-1456; FAA-EE-80-06) Avail: NTIS HC A05/MF A01 CSCL 18/8

This paper reviews radioactive tracer data to determine effective stratosphere-to-troposphere transfer rates for a one-dimensional parameterization. The basic data used are the time-dependent global stratospheric burdens of Zr95 following six Chinese thermonuclear explosions 1967-1976 and also the falloff in burdens of Sr90 and excess C14 following the very large Soviet and U.S. test series of 1961-1962. Results of the Chinese explosions demonstrate that transfer of material from stratosphere to troposphere is fast in winter but slow in the summer of initial injection. It is best modeled by a seasonally varying eddy diffusivity profile, showing 'fast' transport (e.g., Dickinson-Chang, Danielsen) for a winter injection and fast transport delayed to the next winter for a summer injection. Cloud rise height for the 1961-1962 tests is not well known, and so two models for the yield-altitude curve are used: a 'high' (Foley-Ruderman) and a 'low' (Seitz) model. The overall time variation in stratospheric burden of Sr90 and in stratospheric and tropospheric burdens of C14 can be simulated best by relatively fast falloff, i.e., by using a low injection height (Seitz) and fast transport (e.g., Dickinson-Chang). The difference in falloff rate of stratospheric burdens of Sr90 and of C14 is due principally to the recycling of C14 (as CO2) from the troposphere, with minor corrections due to sedimentation of the aerosols carrying Sr90 and the difference in effective injection height of these two tracers. GRA

N81-16666# Aerospace Corp., El Segundo, Calif.
MAGNETOSPHERIC EFFECTS OF ION AND ATOM INJECTIONS BY THE SATELLITE POWER SYSTEM Final Report
Y. T. Chiu, J. G. Luhmann, M. Schulz, and J. M. Cornwall (UCLA)
Argonne, Ill. ANL Jul. 1980 119 p refs
(Contract W-31-109-eng-38)
(ANL/EES-TM-94; SSL-80(9990)-1) Avail: NTIS HC A06/MF A01

A two year assessment of magnetospheric effects of the construction and operation of a satellite power system is reported. This assessment effort is based on application of present scientific knowledge rather than on original scientific research. Mass and energy injections of the system are sufficient to modify the magnetosphere substantially, to the extent of possibly requiring mitigation measures for space systems but not to the extent of causing major redirection of efforts and concepts. The scale of the SPS is so large, that these impressions require verification (or rejection) by in-depth assessment based on original scientific treatment of the principal issues. Approximate limits of magnetospheric modifications are defined. Modifications of the space radiation environment, of the atmospheric airglow background, of the auroral response to solar activity and of the fluctuations in space plasma density are identified as the principal impacts. S.F.

N81-16667# Sandia Labs., Albuquerque, N. Mex.
EUROPEAN EMPIRICAL METHODS APPLIED TO SUBSIDENCE IN U.S. COAL FIELDS
D. E. Munson and W. F. Eichfeld (DOE, Carbondale, Ill.) Oct. 1980 21 p refs
(Contract ET-74-C-01-9067)
(SAND-80-1920) Avail: NTIS HC A02/MF A01

The empirical methods commonly used in Europe to describe the shape of subsidence troughs are tested against the field data of the York Canyon Mine in Northern New Mexico. This mine is in a flat lying seam under rugged terrain. The subsidence data consists of time correlated measurements of surface displacements above two longwall panels. While the profile fits from the graphical methods do not agree with the measured profiles, the profile functions of the error integral type used in continental Europe fit the data well. The profile function analysis of the development curves also suggests a time dependent response of the overburden. These results, except for the specific profile function used, are similar to those found previously for longwall subsidence at the Old Ben No. 24 Mine. Parameter values of the fit were determined for all profiles. These parameters for the development curves and traveling profiles, which fundamentally result from the same raw data, exhibit markedly different apparent scatter. The rather narrow range of values for the development curves suggest that individual points subside in a well-behaved manner; and hence, the large variation in parameter values for the traveling profiles reflects an inadequacy in the analysis in correlation between points. E.D.K.

N81-16668# California Univ., Livermore. Lawrence Livermore Lab. Atmospheric and Geophysical Sciences Div.
GLOBAL DISTRIBUTIONS OF TOTAL OZONE DURING JANUARY AND FEBRUARY 1979 AS DETERMINED FROM DSMP MULTICHANNEL FILTER RADIOMETER MEASUREMENTS
Frederick M. Luther, James S. Ellis, James E. Lovill, Thomas J. Sullivan, and Roger L. Weichel Sep. 1980 10 p refs Presented at Quadrennial Intern. Ozone Symp., Boulder, Colo., 4-9 Aug. 1980 Submitted for publication Sponsored by DOE
(UCRL-84070; CONF-800869-4) Avail: NTIS HC A02/MF A01

Daily analyses of the global distribution of retrieved total ozone are presented for January and February 1979. The temporal and spatial averages and variability of ozone during this period are discussed. Retrieved total column ozone data derived from the MFR measurements for January 1979 are compared with

preliminary SBUV measurements and with distributions of total ozone measured between 1958 and 1967. Author

N81-16669# Geological Survey, Denver, Colo.
A VERTICAL SEISMIC PROFILING EXPERIMENT TO DETERMINE DEPTH AND DIP OF THE PALEOZOIC SURFACE AT DRILL HOEL U10bd, NEVADA TEST SITE, NEVADA
Alfred H. Balch, Myung W. Lee, and D. C. Muller 1980 76 p Sponsored by DOE
(USGS-OFR-80-847) Avail: NTIS HC A05/MF A01

A vertical seismic profile experiment in a drill hole is described. Seismic reflections from the Paleozoic surface beneath the Quaternary and Tertiary deposits of Yucca Flat were obtained. Different sources used to generate seismic energy for vertical seismic profiles were compared. Five profiles were made, two using different surface sources and three using different downhole sources. The seismic signal was detected with a downhole clamping geophone. The reflection from the Paleozoic surface was evident on all five profiles, with no source showing a comparative advantage over the others. Velocity filtering was shown to be an extremely valuable tool for enhancing the reflection from the Paleozoic surface. The vertical seismic profiles suggest that seismic energy trapped in the near surface zone is probably the reason for the limited success of previous attempts to map the Paleozoic surface with surface seismic reflection surveys. Vertical seismic profiling was shown to be a viable method for obtaining reflections from the Paleozoic surface beneath Yucca Flat. Author

N81-16670# Pennsylvania State Univ., University Park. Dept. of Meteorology.
CALCULATION OF ALBEDO AND INFRARED FLUX CALIBRATED BY SATELLITE OBSERVATIONS: RESULTS FOR TIME MEAN VALUES OVER CONTINENTS AND OCEANS AND INTERANNUAL CHANGES OVER LAND
John J. Cahir, Michael D. Fromm, Hans A. Panofsky, and Lanning Penn Aug. 1980 137 p refs
(Grant NOAA-04-6-158-44013)
(PB81-108219; NOAA-80090813) Avail: NTIS HC A07/MF A01 CSCL 04A

Monthly mean albedo and infrared flux was estimated by regression methods, using monthly averaged conventional meteorological variables which are associated with cloudiness and/or cloudiness change as predictors. Developmental equations were derived from 36 months of the 42 month archive of data from NOAA satellites, for the overland work, and of 41 months over the oceans. GRA

N81-16671# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
COMPUTED REFRACTION AND ABSORPTION FLUCTUATIONS CAUSED BY TEMPERATURE, HUMIDITY, AND PRESSURE FLUCTUATIONS: RADIO WAVES TO 5 MICROMETERS
R. J. Hill, S. F. Clifford, and R. S. Lawrence Jun. 1980 108 p refs
(PB81-108292; NOAA-TM-ERL-WPL-59; NOAA-80081104)
Avail: NTIS HC A06/MF A01 CSCL 04A

The dependence of fluctuations in atmospheric absorption and refraction upon fluctuations in temperature, humidity and pressure was found for infrared frequencies. This dependence has contributions from line and continuum absorption and from anomalous refraction by water vapor. The functions that relate these fluctuations are necessary for evaluating degradation of electromagnetic radiation by turbulence. They were computed for a given choice of mean, atmospheric conditions and graphed as functions of frequency in the wavelength range from radio waves to 5 micrometers. It was found that turbulent fluctuations in total pressure give a negligible contribution to absorption and refraction fluctuations. GRA

N81-16672 California Univ., Berkeley.
ELECTROSTATIC ION CYCLOTRON TURBULENCE AND AURORAL PARTICLE ACCELERATION Ph.D. Thesis
Robert Louis Lysak 1980 109 p
Avail: Univ. Microfilms Order No. 8029488

A generalized quasilinear theory of wave particle interactions in a magnetized plasma including resonance broadening effects is developed which is applied to yield estimates of anomalous resistivity, ion heating and cross field diffusion due to EIC waves, as well as electrostatic turbulence on the whistler resonance cone. Strong turbulence effects on ion heating are considered in the approximation of infinite wave autocorrelation time. Ion trapping and the onset of stochasticity in the ion motion which allows ions to become detrapped and accelerated to velocities in excess of the maximum perpendicular velocity allowed by the invariants of motion of the trapped ion were investigated. In the auroral zone, ion heating is limited by the magnetic mirror force which preferentially removes ions of high energy from a localized heating region. Considering this limitation, it is found that ions may be accelerated to energies the order of a hundred times their initial thermal energies in a region extended 10 km along the magnetic field. A model for the excitation of current driven instabilities is proposed in which the intensification of the field aligned current is carried by the shear mode kinetic Alfven wave. Dissert. Abstr.

N81-16673 California Univ., Berkeley.
ALTITUDE DEPENDENCE OF THE RADAR MEASURED PERPENDICULAR ELECTRIC FIELD WITH EVALUATION OF STATISTICAL UNCERTAINTIES AND SYSTEMATIC ERRORS Ph.D. Thesis
D. Kent Cullers 1980 91 p
Avail: Univ. Microfilms Order No. 8029367

Perpendicular electric field measurements with the Chatanika auroral zone radar at altitudes between 200 and 500 km show that the southward component of electric field varies with distance along the magnetic field line during negative bays greater than 500 gamma. During such times, the westward electric field component shows no variation with distance along the magnetic field line within the experimental untertainties. Quantitative analysis of representative data taken during a 1000 gamma negative bay shows an altitude derivative of the southward electric field between 200 and 500 km of -6.8 plus or minus 0.9 mv/m/100 km. This uncertainty is based on a computer simulation of incoherent scatter radar operation and estimates of the size of fluctuations in ionospheric bulk velocity based on observation. Systematic errors in velocity estimation due to improper recovery corrections, shift of ionospheric return signal beyond the receiver bandpass, low signal to noise ratio and a finite duration receiver spectral window were computer simulated but were unable to account for the observed altitude dependence. A possible explanation of the data is the existence of a parallel electric field below 500 km with a magnitude of approximately 10 mv/m. Dissert. Abstr.

N81-16674 California Univ., Berkeley.
MAGNETIC FIELD-ALIGNED CURRENTS IN THE EARTH'S MAGNETOSPHERE Ph.D. Thesis
Cynthia Anne Cattell 1980 163 p
Avail: Univ. Microfilms Order No. 8029348

The S3-3 satellite was the first satellite in the region of low altitude auroral particle acceleration with instruments on board to measure DC and AC electric fields and thermal particle densities, DC magnetic fields and energetic ions and electrons. Currents flowing along the Earth's magnetic field lines supply the energy to drive auroral acceleration processes at altitudes near 1 R sub e. The generator for the field aligned currents derives its energy from the flow of particles in the solar wind across open geomagnetic field lines. Studies of field aligned currents can be divided into two types: (1) the study of the large scale morphology of the currents, and (2) the study of the microscopic plasma processes that are associated with the currents. The study of large scale morphology is primarily a study of the sources of field aligned currents, although it also provides information about the generators and loads in the three dimensional magnetospheric current system. The study of microscopic plasma processes provides information on how the parallel potential drops are supported and on wave particle interactions which also accelerate particles. The measurements from the S3-3 satellite can be used to study magnetized plasmas in a collisionless environment for comparison with theoretical studies and to provide insight into processes which are occurring in other astrophysical systems with magnetospheres less accessible to direct measurement. Dissert. Abstr.

N81-16675 Texas A&M Univ., College Station.
APPARENT ATTENUATION ASSOCIATED WITH SEISMIC WAVE INTERFERENCE IN TWO-COMPONENT CYCLIC STRATIFICATION Ph.D. Thesis
Jagadeesh Ramanna Sonnad 1980 122 p
Avail: Univ. Microfilms Order No. 8101648

Interference effects and dissipation produce frequency selective attenuation. In a one-dimensional stratified medium the observed attenuation is a composite of the apparent attenuation arising from interference effects and dissipation. An understanding of the interference effects and its relation to the parameters of the medium leads to better estimates of dissipation. Depth intervals in the earth are modeled as two-component cyclic zones. Synthetic seismograms are used to generate the response which include the interference effects. Interference effects for both nondissipative and dissipative zones are analyzed. The layer thicknesses are generated from a uniform distribution with specified minimum and maximum values. Apparent attenuation values depend not only on the parameters of the layers but also on their arrangement. On the basis of the dependence of the apparent attenuation on the model parameters situations for which estimates of dissipation can be made are outlined. Dissert. Abstr.

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N81-16676# Committee on Science and Technology (U. S. House).
CENTRALIZED STORM INFORMATION SYSTEM
Washington GPO 1980 22 p Hearing before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 161, 14 Oct. 1980
(GPO-69-030) Avail: Subcommittee on Space Science and Application

A promising development for improving severe storms forecasting is the centralized storm information system, a joint NOAA-NASA project. The system consists of three minicomputers and four interactive terminals. One of the computers, the data base manager, codes and maintains a current file of meteorological data, receives satellite imagery, and is linked to radar. The second processor, the applications processor, performs operations on the data as directed by the forecaster. The third computer and one terminal are devoted to developmental work so that new techniques can be implemented and tested without impacting the operational systems. The system will provide immediate improvement in the timeliness of the data available to forecasters. A.R.H.

N81-16677*# National Aeronautics and Space Administration. Pasadena Office, Calif.
CAT ALTITUDE AVOIDANCE SYSTEM Patent Application
Bruce L. Gary, inventor (to NASA) (JPL, California Inst. of Technology, Pasadena) Filed 12 Jan. 1981 21 p
(Contract NAS7-100)
(NASA-Case-NPO-15351-1; US-Patent-Appl-SN-224231) Avail: NTIS HC A02/MF A01 CSCL 04B

A method and apparatus are described for indicating the altitude of the tropopause or of an inversion layer in which clear air turbulence (CAT) may occur and the likely severity of any such CAT. A plot of altitude (with respect to an aircraft) versus temperature of the air at that altitude can indicate when an inversion layer is present and can indicate the altitude of the tropopause or of such an inversion layer. The plot can also indicate the severity of any CAT in an inversion layer. If CAT was detected in the general area, then the aircraft can be flown at an altitude to avoid the tropopause or inversion layer. The detection method can also be utilized to enable an aircraft to fly at an altitude at which the winds are most favorable for reducing fuel consumption. T.M.

N81-16678*# Texas A&M Univ., College Station. Dept. of Meteorology.
ATMOSPHERIC STRUCTURE DETERMINED FROM SATELLITE DATA
Keith Shelburne Knight and James R. Scoggins 1981 107 p refs Sponsored in part by NASA
(Grant DAAG29-76-G-0078)
(NASA-RP-1071; M-328) Avail: NTIS HC A06/MF A01 CSCL 04B

The capabilities of the Nimbus 6 satellite sounding data for use in synoptic analysis were considered and interpreted. An evaluation of the ability of the satellite sounding data to detect and depict structural features of the atmosphere was made on the basis of vertical profiles of average difference and standard deviation of differences between satellite and rawinsonde data at nine pressure levels from 850 to 100 mb; and constant pressure charts and cross sections of satellite, rawinsonde and difference values. Results indicate that satellite measurements of temperature as well as the vertical lapse rate and horizontal gradient of temperature are accurate enough to show large scale patterns but not to precisely define fronts or tropopauses; satellite measurements of dew point temperature are smoothed enough to severely reduce contrasts between air masses across fronts; the magnitude of the standard deviation of differences between rawinsonde and satellite data for most variables increases with the synoptic activity in the region; and the most reliable variables to examine from satellite data for depiction of synoptic features are the temperature equivalent potential temperature and mixing ratio. T.M.

N81-16679*# Texas A&M Univ., College Station. Dept. of Meteorology.
COMPARISONS BETWEEN NIMBUS 6 SATELLITE AND RAWINSONDE SOUNDINGS FOR SEVERAL GEOGRAPHICAL AREAS
Nine-Min Cheng and James R. Scoggins 1981 76 p refs Sponsored in part by NASA
(Grant DAAG29-76-G-0078)
(NASA-RP-1073; M-330) Avail: NTIS HC A05/MF A01 CSCL 04B

Good agreement between satellite and weighted (linearly interpolated) rawinsonde temperature and temperature derived parameters was found in most instances with the poorest agreement either near the tropopause region or near the ground. However, satellite moisture data are highly questionable. The smallest discrepancy between satellite and weighted mean rawinsonde temperature and parameters derived from temperature was found over water and the largest discrepancy was found over mountains. Cumulative frequency distributions show that discrepancies between satellite and rawinsonde data can be represented by a normal distribution except for dew point temperature. T.M.

N81-16680*# Dayton Univ., Ohio.
CASE STUDIES OF CLEAR AIR TURBULENCE USING THE DIAGNOSTIC RICHARDSON NUMBER TENDENCY FORMULATION Final Report
John L. Keller and Patrick A. Haines Washington, D.C. NASA Jan. 1981 62 p refs
(Contract NAS8-32111)
(NASA-CR-3378; UDR-TR-80-97) Avail: NTIS HC A04/MF A01 CSCL 04B

The results of four case studies of clear air turbulence (CAT) using the diagnostic Richardson number tendency (DRT) formulation are highlighted. The performance of this technique in resolving regions of documented CAT encounters is encouraging. Its operational adaptability appears particularly attractive in that input data can be supplied by the currently operational rawinsonde system. Two CAT indices are calculated deterministically, sensing synoptic scale changes in static stability and vertical wind shear conductive for supporting mesoscale CAT layers. These two indices reveal volumes of the troposphere which act as source regions for patches of CAT. The first, the time to reach the critical Richardson number necessary for the initiation of turbulent conditions, was first used by Oard (1974). A second index is devised which is an adaptation of Roach's (1970) work relating synoptic scale and mesoscale energetical coupling and gives more information on the relative intensity of these source regions. The output from the DRT computer module highlights specific regions of the atmosphere which can be interpreted operationally in terms of a CAT encounter probability. Author

N81-16681*# MCS, Inc., Boulder, Colo.
AN AIRPORT WIND SHEAR DETECTION AND WARNING SYSTEM USING DOPPLER RADAR: A FEASIBILITY STUDY
John McCarthy, Edward F. Blick, and Kim L. Elmore Jan. 1981 95 p refs
(Contract NAS8-33458)
(NASA-CR-3379) Avail: NTIS HC A05/MF A01 CSCL 04B

A feasibility study was conducted to determine whether ground based Doppler radar could measure the wind along the path of an approaching aircraft with sufficient accuracy to predict aircraft performance. Forty-three PAR approaches were conducted, with 16 examined in detail. In each, Doppler derived longitudinal winds were compared to aircraft measured winds; in approximately 75 percent of the cases, the Doppler and aircraft winds were in acceptable agreement. In the remaining cases, errors may have been due to a lack of Doppler resolution, a lack of co-location of the two sampling volumes, the presence of eddy or vortex like disturbances within the pulse volume, or the presence of point targets in antenna side lobes. It was further concluded that shrouding techniques would have reduced the side lobe problem. A ground based Doppler radar operating in the optically clear air, provides the appropriate longitudinal winds along an aircraft's intended flight path. E.D.K.

N81-16682*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
ZERO-GRAVITY AEROSOL BEHAVIOR Final Report
Harry W. Edwards Washington NASA Jan. 1981 62 p refs
(Contract NAS8-31673)
(NASA-CR-3384) Avail: NTIS HC A04/MF A01 CSCL 04B

The feasibility and scientific benefits of a zero gravity aerosol study in an orbiting laboratory were examined. A macroscopic model was devised to deal with the simultaneous effects of diffusion and coagulation of particles in the confined aerosol. An analytical solution was found by treating the particle coagulation and diffusion constants as ensemble parameters and employing a transformation of variables. The solution was used to carry out simulated zero gravity aerosol decay experiments in a compact cylindrical chamber. The results demonstrate that the limitations of physical space and time imposed by the orbital situation are not prohibitive in terms of observing the history of an aerosol confined under zero gravity conditions. While the absence of convective effects would be a definite benefit for the experiment, the mathematical complexity of the problem is not greatly reduced when the gravitational term drops out of the equation. Since the model does not deal directly with the evolution of the particle size distribution, it may be desirable to develop more detailed models before undertaking an orbital experiment. J.M.S.

N81-16683*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Lab. for Atmospheric Sciences.
ENERGY-BALANCE CLIMATE MODELS
Gerald R. North, Robert F. Cahalan, and James A. Coakley, Jr. (National Center for Atmospheric Research, Boulder, Colo.) Sep. 1980 148 p refs Submitted for publication Sponsored in part by NSF
(NASA-TM-82047) Avail: NTIS HC A07/MF A01 CSCL 04B

An introductory survey of the global energy balance climate models is presented with an emphasis on analytical results. A sequence of increasingly complicated models involving ice cap and radiative feedback processes are solved and the solutions and parameter sensitivities are studied. The model parameterizations are examined critically in light of many current uncertainties. A simple seasonal model is used to study the effects of changes in orbital elements on the temperature field. A linear stability theorem and a complete nonlinear stability analysis for the models are developed. Analytical solutions are also obtained for the linearized models driven by stochastic forcing elements. In this context the relation between natural fluctuation statistics and climate sensitivity is stressed. Author

N81-16684*# City Coll. of the City Univ. of New York.
INVESTIGATION OF MODELS FOR LARGE-SCALE METEOROLOGICAL PREDICTION EXPERIMENTS Final Report
Jerome Spar 31 Jan. 1981 56 p refs
(Grant NGR-33-016-086)
(NASA-CR-163870) Avail: NTIS HC A04/MF A01 CSCL 04B

An attempt is made to compute the contributions of various surface boundary conditions to the monthly mean states generated by the 7 layer, 8 x 10 GISS climate model (Hansen et al., 1980), and also to examine the influence of initial conditions on the model climate simulations. Obvious climatic controls as the shape and rotation of the Earth, the solar radiation, and the dry composition of the atmosphere are fixed, and only the surface boundary conditions are altered in the various climate simulations. A.R.H.

N81-16685*# Morgan State Univ., Baltimore, Md. Dept. of Mathematics.
ASSESSMENT OF THE QUALITY OF GATE AREA RAINFALL DATA FROM A NIMBUS-5 RADIOMETER Final Report
Nathaniel Knox and Rosalind R. Cottrell Feb. 1981 18 p refs
(Grant NAG5-14)
Avail: NTIS HC A02/MF A01 CSCL 04B

The quality of rainfall intensity estimates derived from passive microwave measurements by the electrically scanned microwave radiometer (ESMR-5) aboard the Nimbus 5 satellite are evaluated. The microwave measurements used are those coincident with the global atmospheric research program Atlantic tropical experiment (GATE). The ESMR 5 derived rainfall intensity estimates are compared with hourly averaged GATE radar rainfall measurements. It is determined from the transfer curves derived using the radar measurements as ground truth, that the ESMR 5 derived data consistently over estimates rainfall by a factor of approximately 1.4. E.D.K.

N81-16686*# Tennessee Univ., Tullahoma.
STATISTICAL ANALYSIS OF ATMOSPHERIC TURBULENCE ABOUT A SIMULATED BLOCK BUILDING Final Report
Sidney L. Steely, Jr. Washington NASA Jan. 1981 186 p refs
(Contract NAS8-32692)
(NASA-CR-3366) Avail: NTIS HC A09/MF A01 CSCL 04B

An array of towers instrumented to measure the three components of wind speed was used to study atmospheric flow about a simulated block building. Two-point spacetime correlations of the longitudinal velocity component were computed along with two-point spatial correlations. These correlations are in good agreement with fundamental concepts of fluid mechanics. The two-point spatial correlations computed directly were compared with correlations predicted by Taylor's hypothesis and excellent agreement was obtained at the higher levels which were out of the building influence. The correlations fall off significantly in the building wake but recover beyond the wake to essentially the same values in the undisturbed, higher regions. Author

N81-16687# Naval Postgraduate School, Monterey, Calif.
IMPROVEMENT IN TROPICAL CYCLONE FORECASTS BY MULTIPLE LINEAR REGRESSION EQUATION ADJUSTMENT OF ANALOG TRACKS M.S. Thesis
Kenneth Allen Peterson Jun. 1980 48 p refs
(AD-A092139) Avail: NTIS HC A03/MF A01 CSCL 04/2

A statistical technique is tested for adjusting the analog storm tracks used in the Northwest Pacific Analog Tropical Cyclone Forecasting Program (TYAN78). In the present version, the tracks are rotated based on linear extrapolation of the deviations of the past 12-h motion for the analog and the current storm. The technique proposed here uses multiple linear regression equations to adjust the 12-h through 72-h analog positions. Predictors include translation speeds along the analog track from the -36-h to 72-h positions plus the comparison of the past 12-, 24- and 36-h translated positions of the analog with the current storm. By simply averaging the regression adjusted positions, the vector forecast errors were smaller than the TYAN78 errors. Both the TYAN78 and regression adjusted forecast errors were less than the official JTWC forecast errors. The improvement in the regression adjusted forecasts was in a smaller standard deviation relative to the mean position. For example, in the dependent sample the mean errors at 72-h for the official forecast, TYAN78 forecast and regression adjusted forecast were 438, 321, and

288 nautical miles, respectively. The corresponding standard deviations were 198, 151, 162 nautical miles. GRA

N81-16688# Naval Postgraduate School, Monterey, Calif.
STATISTICAL ADJUSTMENT OF THE HATRACK TYPHOON TRACK FORECASTING MODEL
Ronald Charles Gilchrist Jun. 1980 66 p refs
(AD-A092411) Avail: NTIS HC A04/MF A01 CSCL 04/2

A statistical technique proposed by Elsberry and Frill (1980) for adjusting dynamical tropical cyclone motion forecasts is extended to the Hurricane and Typhoon Tracking (HATRACK) scheme of Renard, et al (1968). The objective is to eliminate systematic HATRACK errors through use of linear regression equations. Predictors derived from comparison of backward integration of the HATRACK model with known positions of the storm are included to relate past HATRAC performance with future performance. The predictors also include translation speeds along the -36 hr to -72 hr track plus position and radius of the storm at the initial time. Regression equations are derived from dependent samples of 60 and 61 storms for the 500, 700 and 850 mb steering levels. Tests of the equations with the dependent samples indicate improvement over typical forecast error averages. The regression scheme approaches the same error distribution with time regardless of steering level. In tests with an independent sample of 31 storms, the regression equations were able to reduce the systematic longitudinal/latitudinal errors at all levels. In these tests, the regression scheme reduced HATRACK bias more efficiently than the bias correction of the Modified Hurricane and Typhoon Tracking (MOHATT) model. GRA

N81-16689# Naval Postgraduate School, Monterey, Calif.
A STATISTICAL ANALYSIS OF WESTERN NORTH PACIFIC OCEAN TROPICAL CYCLONE DANGER AREA FORECASTS M.S. Thesis
Terry Dean Snow Sep. 1980 50 p refs
(AD-A092408) Avail: NTIS HC A03/MF A01 CSCL 04/2

This study investigates 24 hr forecasts of 30 kt wind danger areas for western North Pacific Ocean tropical cyclones. The forecasts for 1979 have been verified against the 30 kt wind areas observed over a period of 24 hours. The threat scores of these verifications have been statistically analyzed. The dependency of threat scores on the five parameters: (a) speed of movement, (b) maximum observed wind, (c) direction of movement, (d) latitude and (e) longitude, was found to exist at the 1% level of significance. GRA

N81-16690# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A CYLINDRICAL CLOUD MODEL FOR MICROWAVE AND INFRARED RADIATIVE TRANSFER APPLICATIONS TO DEFENSE METEOROLOGICAL SATELLITE PROGRAM MICROWAVE SOUNDERS Ph.D. Thesis - Utah Univ.
Grant Clifford Aufderhaar Mar. 1980 162 p refs
(AD-A092439; AFIT-CI-80-3D) Avail: NTIS
HC A08/MF A01 CSCL 04/2

Analytical solutions to the thermal radiative transfer equation for one and two dimensional cylindrical geometries for an isothermal cloud cylinder are derived using a truncated spherical harmonics expansion for the intensity and scattering phase function. Higher order approximations are generated by utilizing the recursion properties of the modified Bessel functions. Computational results are presented and physically discussed for a hypothetical atmosphere in the infrared 10 micron wavelength and in a realistic atmosphere in the microwave 50-60 GHz frequencies. Comparisons are made with a discrete-ordinate plane-parallel model and finite cubic and rectangular models in the infrared region and with a discrete-ordinate plane-parallel model in the microwave region. Results demonstrate that finite clouds have emissivities less than those of plane-parallel clouds and that optically thick cylindrical clouds should not be considered as black clouds. Further, the effect of the angle of observation of the satellite on remote sensing of a cloud pattern is demonstrated to be significant. Case studies are presented utilizing Defence Meteorological Satellite Program microwave sounder data along with standard meteorological data. Calculations for nonprecipitating and clear cases were similar and in good agreement with observations. GRA

N81-16691# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
KINEMATIC FEATURES OF THE LARGE-SCALE MEAN STATE PHASE 2 OF GATE AND COMPARISON WITH PHASE 3 FEATURES M.S. Thesis - Purdue Univ.
Robert Gordon Hughes Aug. 1980 89 p refs
(AD-A092444; AFIT-CI-80-39T) Avail: NTIS
HC A05/MF A01 CSCL 04/2

Large-scale wind field features are presented for Phase 2 of the Gobal Atmospheric Research Program's (GARP) Atlantic Tropical Experiment (GATE) and compared with those of Phase 3. GATE took place over western Africa and the tropical eastern Atlantic in 1974. Phase 2 was from 28 July to 17 August and Phase 3 was from 30 August to 19 September. Presented here are streamline and isotach analyses, derived horizontal winds, kinematic vertical motion, horizontal divergence, and vorticity including the vorticity budget terms. During Phase 2, low-level circulation was dominated by convergence and cyclonic vorticity over land; however, over water, divergence dominated. This result and the related patterns of vertical motion seem to be a major difference between circulation features of Phase 2 and Phase 3. Many investigators note that with regard to cloudiness, convection, rainfall, and wave organization and structure, Phase 3 was more active than Phase 2. Comparisons of the analyzed and derived wind data and kinematic variables from this study and that of Vincent and Scott (1980) are made in an attempt to relate these differences in activity to the above findings. GRA

N81-16692# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A NEW HORIZONTAL GRADIENT, CONTINUOUS FLOW, ICE THERMAL DIFFUSION CHAMBER AND DETAILED OBSERVATION OF CONDENSATION-FREEZING AND DEPOSITION NUCLEATIONS Ph.D. Thesis - Utah Univ.
Edward Mason Tomlinson Jun. 1980 127 p refs
(AD-A092479; AFIT-CI-80-21D) Avail: NTIS
HC A07/MF A01 CSCL 04/2

In the attempt to develop a new horizontal gradient, continuous flow, ice thermal diffusion chamber, a number of new schemes have been devised. The subsequent use of the chamber for ice nucleus measurements has resulted in a number of new findings both in the technology of instrumentation for ice nucleus studies and in the mechanisms and nucleating behaviors of both natural and artificial ice nuclei. GRA

N81-16693# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Dept. of Meteorology.
DIGITAL DOPPLER RADIAL VELOCITY DATA COMPARED OBJECTIVELY WITH DIGITAL REFLECTIVITY RADAR DATA M.S. Thesis - Texas A&M Univ.
Thomas Foster Beaver May 1980 124 p refs
(AD-A092318; AFIT-CI-80-11T) Avail: NTIS
HC A06/MF A01 CSCL 17/9

An investigation was conducted to determine the feasibility of objectively analyzing digital Doppler radial velocity data at constant altitudes. Data were supplied by the National Severe Storms Laboratory at Norman, Oklahoma. The study area was a 96 km by 116 km box surrounding the Chickasha, Oklahoma, synoptic network. A computer program, initially developed by Greene in 1971 and subsequently modified, was used as the basis for this computer program development. This research demonstrated that mesocyclones could be located using constant altitude radial velocity maps (CAVM) on a 2 km horizontal and a 1 km vertical grid scale without correcting for storm motion. However a 1 km horizontal and vertical grid scale was found to be 'optimum' for location and study of mesocyclones. Constant altitude velocity maps (CAVM) were then compared with constant altitude reflectivity maps (CAZM). This comparison, using two different storms, demonstrated that CAVM analysis was superior to CAZM analysis for the detection of severe storm areas. GRA

N81-16694# Air Force Geophysics Lab., Hanscom AFB, Mass.
OBJECTIVE PREDICTION OF SLANT VISUAL RANGE DURING ADVECTIVE FOG SITUATIONS Scientific Interim Report
Edward B. Geisler and Russell C. Dengel (Systems and Applied Sciences Corp., Lexington, Mass.) Nov. 1980 7 p refs Presented at the 8th Conf. on Weather Forecasting and Anal. of the AMS,

Denver, 10-13 Jun. 1980
(AF Proj. 6670)
(AD-A092697; AFGL-TR-80-0330) Avail: NTIS HC A02/MF A01 CSCL 04B

The final phase of the Air Force Geophysics Laboratory development and evaluation of a remote tower slant visual range (SVR) system is described. Remote tower forward scatter meter measurements of atmospheric extinction coefficient are used to estimate the SVR in the simulated approach zone. Three prediction techniques, Markov, Regression Estimate of Event Probabilities (REEP), and Equivalent Markov, are evaluated and yield probability estimates of below-limit SVR conditions for forecast times to 1 h. For Categories 1 and 2 conditions, such a system would have a probability of detection of below-limit SVR conditions of 91%. The Equivalent Markov technique is shown to provide accurate and reliable forecasts and yield slightly better results than Markov and REEP. GRA

N81-16695# Naval Postgraduate School, Monterey, Calif. Dept. of Meteorology.

A STATISTICAL STUDY OF MONTHLY STORMINESS AND SEA SURFACE TEMPERATURE ANOMALIES OVER THE NORTH PACIFIC OCEAN M.S. Thesis

William H. Little Jun. 1980 82 p refs
(AD-A092134) Avail: NTIS HC A05/MF A01 CSCL 08/10

Empirical Orthogonal Function (EOF) and cross-correlation analysis were used to examine the interrelationships between anomalous wind forcing and anomalous sea surface temperature (SST) over the North Pacific Ocean for the period January 1969 through December 1978. GRA

N81-16696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

THE INFLUENCE OF CLOUD AND ATMOSPHERIC MOISTURE ON THE STATISTICAL ANALYSIS OF NIMBUS 6 MULTISPECTRAL RADIATION MEASUREMENTS M.S. Thesis - Utah Univ.

Peter Werner Speck Aug. 1980 129 p refs
(AD-A092217; AFIT-CI-80-43T) Copyright. Avail: Air Force Inst. of Technology, Wright-Patterson AFB, Ohio CSCL 04/2

A study of the Earth-atmosphere system with multispectral remote sensing measurements from Nimbus VI satellite was carried out over the North American continent when a mid-latitude cyclone was present. Correlative information between such conventional meteorological parameters as clouds, precipitation, atmospheric temperature, snow cover, and soil moisture was made with measurements from the SCAMS, ESMR, and HIRS experiments on Nimbus VI. The results showed SCAMS microwave measurements were most sensitive to atmospheric parameters such as temperature and precipitating clouds while ESMR microwave measurements were dependent on surface conditions especially snow cover and soil moisture. Infrared and reflected solar radiance measurements from HIRS were useful in identifying cloud areas with conventional meteorological data. GRA

N81-16697# Air Force Geophysics Lab., Hanscom AFB, Mass. Meteorology Div.

WIND DISTRIBUTIONS AND INTERLEVEL CORRELATIONS, SURFACE TO 60 KM Environmental Research Papers

Arthur J. Kantor and Allen E. Cole 19 Aug. 1980 112 p refs
(AF Proj. 6670)
(AD-A092670; AFGL-TR-80-0242; AFGL-ERP-713) Avail: NTIS HC A06/MF A01 CSCL 04/2

Information is provided in this report on the interlevel correlations of the east/west and north/south wind components for altitudes between the surface and 60 km, with special emphasis on levels between 25 km and 60 km. Mean monthly wind speeds and day-to-day variations due to synoptic changes in weather patterns are included. Estimates are also given of the probability of extreme wind speeds at specific locations and altitudes up to 60 km. A statistical technique that can be used to obtain estimates of the integrated effect of wind on the trajectories and impact points of reentry vehicles is presented, and an example of its application is given. These effects due to the winds must be considered, along with the density effects, in the design and operation of guidance systems for reentry vehicles and for targeting ballistic missiles. GRA

N81-16698# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Geophysical Sciences.

LATITUDINAL AND VERTICAL RELATIONSHIP BETWEEN TROPOSPHERIC OZONE AND WATER VAPOR AS MEASURED IN PROJECT GAMETAG M.S. Thesis

Francis X. Routhier Jun. 1980 213 p refs
(AD-A092518; AFIT-CI-80-18T) Avail: NTIS HC A10/MF A01 CSCL 04/2

Reported are the O3 and dewpoint data recorded during the 1977 and 1978 GAMETAG field experiments. These data are primarily those recorded aboard an aircraft during horizontal flight legs at altitudes between 5 - 6.5 kilometers (free troposphere) and below one kilometer (boundary layer). The total latitude range covered was 70 N to 58 N and involved flight operations over Canada, Alaska, the eastern and central North Pacific, and the central and western South Pacific. A comparison of the GAMETAG ozone and dewpoint data shows a significant negative correlation between O3 and dewpoint, or if the comparison is made with dewpoint depression, a significant positive correlation. The strongest negative correlation between O3 and dewpoint appears at those latitudes showing the highest ozone variability. This negative correlation when coupled with the presence of ozone layering implies that a major source of the ozone observed during the GAMETAG flights was that resulting from the downward sloping transport of ozone rich upper tropospheric or lower stratospheric air. GRA

N81-16699# Air Weather Service, Scott AFB, Ill. Forecasting Services Div.

THE WC-130 METEOROLOGICAL SYSTEM AND ITS UTILIZATION IN OPERATIONAL WEATHER RECONNAISSANCE

Rodney S. Henderson Aug. 1980 91 p refs
(AD-A092637; AWS/TR-80-002) Avail: NTIS HC A05/MF A01 CSCL 04/2

This report discusses the U.S. Air Force WC-130 weather reconnaissance system. It starts with a brief history of weather reconnaissance, then describes the Air Force WC-130 weather reconnaissance system including descriptions of the instrumentation used. The discussion of data dissemination and quality control is followed by discussion of the applications of weather reconnaissance in watching tropical cyclones and in weather modification. GRA

N81-16700# Naval Postgraduate School, Monterey, Calif. Dept. of Physics and Chemistry.

AN ANALYSIS OF LIDAR ATMOSPHERIC REMOTE SENSING M.S. Thesis

Dale Robert Hamon Jun. 1980 102 p refs
(AD-A092573) Avail: NTIS HC A06/MF A01 CSCL 04/2

The analysis of scattered electromagnetic radiation is examined in terms of Mie theory establishing the detailed form for the scattering functions. These parameters are used to define the criterion whereby the composition and number densities of an atmospheric aerosol population may be assessed. Laser radar, or LIDAR, is the proposed remote sensing device and the governing system equations are developed. The problem of data inversion is surveyed with emphasis on smoothing methods, statistical analyses, and iterative techniques. A discussion of the numerical stability of the solution is also presented. On the bsis of the Mie model, inversion of the data provided by the LIDAR probe is given as a rationale to effect as estimate of the true particle number distribution function in an atmospheric cell. GRA

N81-16701# California Univ., Livermore. Lawrence Livermore Lab.

TWO-DIMENSIONAL SLOPE WIND SIMULATIONS IN THE FINITE ELEMENT APPROXIMATION

Dieter R. Tuerpe Jun. 1980 17 p refs Presented at ASCOT Program Planning Meeting, Gettysburg, Pa., 15-18 Apr. 1980
(Contract W-7405-eng-48)
(UCRL-84534; CONF-800480-4) Avail: NTIS HC A02/MF A01

A hydrostatic fluid dynamics model was used to simulate the development of katabatic winds. This model solves the Navier-Stokes equations in the Boussinesq approximation by the finite element method. To obtain physically reasonable results one has to choose unequal diffusion parameters in the horizontal

(K sub x) and vertical (K sub z). Profiles of the downslope velocities are presented at different points in the flow. As expected, the magnitude of the vertical diffusion coefficient K sub z controls the depth of the flow which seems to increase only slightly with downhill distance and the magnitude of the flow increases with cooling rate and slope. Author

N81-16702# Battelle Pacific Northwest Labs., Richland, Wash. Atmospheric Sciences Dept.
MASS-CONSISTENT, INTERPOLATED WIND FIELDS FOR COMPLEX TERRAIN
R. L. Drake and C. H. Huang Sep. 1980 8 p refs Presented at Symp. on Intermediate Range Atmospheric Transport Processes and Technol. Assessment, Gatlinburg, Tenn., 1-3 Oct. 1980
(Contract DE-AC06-76RL-01830)
(PNL-SA-8678; CONF-801064-4) Avail: NTIS HC A02/MF A02

Mass-consistent modeling is an attempt to derive snapshots of the mean wind field over a section of terrain from given sets of measured wind fields. The modeling scheme presented is based on the assumption that the best mass-conserving wind field is a strong function of the interpolation technique for the measured winds and a weak function of the mass conservation scheme. The proposed scheme includes the following special features: a terrain-following coordinate system; an arbitrarily defined upper boundary; and a provision for density stratification. The accuracy and utility of the scheme was tested against an analytically derived wind field flowing over an analytically defined terrain. Author

N81-16703# Water and Power Resources Service, Denver, Colo.
HIPLEX RAWINSONDE SKEW T-LOG P ANALYSES, 1979
Francis E. Politte, David A. Matthews, and G. A. Mentgen Jun. 1980 59 p refs
(PB81-104952) Avail: NTIS HC A04/MF A01 CSCL 04B

Thermodynamic analyses of stability and moisture for all HIPLEX rawinsonde observations were plotted on skew T log P diagrams and wind vectors were plotted at mandatory levels. Soundings were observed at Miles City, Montana; Baker, Montana; and seven mesoscale network sites near Big Spring, Texas; from May through July 1979. This report provides documentation on the method of observation, data reduction techniques, and analysis software available on the Service's Environmental Data Network. GRA

N81-16704# National Weather Service, Salt Lake City, Utah.
REGRESSION EQUATION FOR THE PEAK WIND GUST 6 TO 12 HOURS IN ADVANCE AT GREAT FALLS DURING STRONG DOWNSLOPE WIND STORMS
Michael J. Oard Jul. 1980 19 p refs
(PB81-108367; NOAA-TM-NWS-WR-154; NOAA-80082002)
Avail: NTIS HC A02/MF A01 CSCL 04B

Strong downslope winds are common in Montana along the East Slopes of the Rockies from fall to spring. Wind gusts over 100 MPH occur in some areas each year producing property damage and personal injuries. These winds occur in a variety of synoptic weather patterns, but the most frequent with the strongest winds occur in well defined warm air advection patterns ahead of an eastward advancing upper trough. This suggests that the speed of downslope winds for these cases can be objectively predicted with a multiple regression equation. An objective criterion was developed that would alert the forecaster to the synoptic potential for damaging winds so that a high wind warning can be issued well in advance, if needed. GRA

N81-16705# National Weather Service, Salt Lake City, Utah. Western Region.
LIGHTNING ACTIVITY LEVELS
Mark A. Mollner Jul. 1980 21 p refs
(PB81-108300; NOAA-NWS-WRCP-14; NOAA-80081102)
Avail: NTIS HC A02/MF A01 CSCL 04B

This program computes Lightning Activity Level (LAL) and J. R. Sims cloud cover (SCC) forecasts for the Western United States. The resultant LAL/SCC forecast map can be used routinely in the briefing of Land Management Agencies at BIFC (Boise Interagency Fire Center). Western Region Fire Weather forecasters will recognize that this LAL/SCC forecast map is essentially the same as was distributed on RAFAX a few years ago. The program is written in Data General FORTRAN IV. For computation of the LAL/SCC forecast, a small amount of edit work to one RDOS file on an AFOS ADM is needed. However, once AFOS is fully operational, this step can be performed by the AFOS minicomputer. GRA

N81-16706# National Weather Service, Salt Lake City, Utah.
AN OPERATIONAL EVALUATION OF THE SCOFIELD/OLIVER TECHNIQUE FOR ESTIMATING PRECIPITATION RATES FROM SATELLITE IMAGERY
Richard Ochoa Aug. 1980 27 p refs
(PB81-108227; NOAA-TM-NWS-WR-157; NOAA-80090202)
Avail: NTIS HC A03/MF A01 CSCL 04B

Although the number of cases is small, some interesting cases illustrating potential weaknesses of the technique in the western United States are discussed. Recommendations for eliminating these weaknesses are given. GRA

N81-16707# National Weather Service, Honolulu, Hawaii.
THE ESTIMATION OF CIRRUS CLOUD OVER OAHU
Michael J. Morrow Aug. 1980 17 p refs
(PB81-108086; NOAA-NWS-TMS-PR-21; NOAA-80091508)
Avail: NTIS HC A02/MF A01 CSCL 04B

While this study deals with and presents a climatology of cirrus as observed from Oahu, it is indicated that the results will, with some modification, be useful on the Big Island and Maui. Satellite pictures indicate more cirrus cloudiness over the southern islands than over Oahu. GRA

N81-16708# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
FM-CW RADAR OBSERVATIONS IN NORTHEASTERN COLORADO COMPARED WITH RAWINSONDE-MEASURED PROFILES OF REFRACTIVE INDEX
E. E. Gossard, R. Chadwick, and D. Wolfe May 1980 40 p refs
(PB81-108276; NOAA-TM-ERL-WPL-57; NOAA-80081319)
Avail: NTIS HC A03/MF A01 CSCL 04B

Three balloons a day were launched while the radar operated in a vertically pointing, non-Doppler mode. It was concluded that the radar is a reliable detector of elevated refractive layers. In fact it provides a better estimate of the height and persistency of such layers than do balloon soundings because layers undulate and the refractive index distribution is often transient and patchy. Single balloon sounding data cannot provide the important persistency information. Insects are shown to be an important contaminant in the radar observations. It was demonstrated that insect targets are adequately separated from the clear air returns if the range resolution of the radar is good. GRA

N81-16709# National Climatic Center, Asheville, N. C.
A LONG RECORD OF WEATHER OBSERVATIONS IN SOUTHEASTERN IOWA, 1839-1979
Henry F. Diaz Jul. 1980 91 p refs
(PB81-108201; NOAA-80090808) Avail: NTIS HC A05/MF A01 CSCL 04B

The following variables are summarized: mean monthly and annual temperature; monthly and annual total precipitation; mean monthly and annual maximum and minimum temperature; highest and lowest monthly and annual maximum and minimum temperature; highest and lowest monthly and annual temperature; seasonal mean temperature (Winter: Dec-Feb, Spring: Mar-May, etc); seasonal total precipitation; total monthly and seasonal (Oct-Apr) snowfall; the dates of last frost (or 32 deg F temperature) in spring and the first one in autumn; and the number of clear and cloudy days per month. Time series graphs are presented for seasonal and annual temperature and precipitation and seasonal snowfall totals. GRA

N81-16710# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
A COMPARISON OF RADAR BACKSCATTER PROFILES WITH RAWIN METEOROLOGICAL PROFILES
R. B. Chadwick, G. Morrison, R. Zamora, and E. E. Gossard Jun. 1980 92 p refs
(PB81-102527; NOAA-TM-ERL-WPL-58; NOAA-80082001)
Avail: NTIS HC A05/MF A01 CSCL 04B

The results of 2-1/2 months of data collected in the late summer and fall of 1977 with an FM-CW Radar of the Wave Propagation Laboratory is presented. Profiles were compared from the local rawinsonde with the frequency distribution of the signal for the two hours of the day containing the local rawinsonde observation. In these observations the radar was located at Buckley Field near Denver, Colorado about four miles from Stapleton Airport where the rawinsonde was taken. It was concluded that any radar system that is to be used to deduce meteorological stratification must have fine enough spatial resolution to resolve insects and separate their return from the Bragg return from the clear air. GRA

N81-16711# AIROA, Inc., Pagosa Springs, Colo.
FIELD SITE DIRECTION OF PREPARATORY OBSERVATION FOR DETERMINING EFFECTIVENESS OF PROGRAM OF APPLIED WEATHER MODIFICATION IN THE CANARY ISLANDS Final Report
Albert H. Schnell 12 Jul. 1980 132 p refs
(Contract DI-0-07-85-V0031)
(PB81-107997) Avail: NTIS HC A07/MF A01 CSCL 04B

Work conducted in the 1979-1980 season consisted of observation of small convective systems within the sea of clouds over the Canarian Archipelago, using ground based radar and airborne instrumentation, Cloud Condensation Nuclei counter and simple drop-recording equipment. These observations fall under a preliminary studies phase. Three basic cloud types were identified and are considered for further detailed studies: warm sea clouds, warm orographic clouds, and cold clouds. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N81-16712# Jaycor, Woburn, Mass.
A COMPARISON STUDY AND SOFTWARE IMPLEMENTATION OF NORDA OCEAN MODELS Final Report, 6 Aug. 1979 - 5 May 1980
Liang-Bee Lin 8 Oct. 1980 43 p
(Contract N00014-79-C-0874)
(AD-A092424; JAYCOR-PSD-200-80-008FR) Avail: NTIS HC A03/MF A01 CSCL 08/3

During the course of this research, three technical areas have been addressed: (1) eddy-meanflow energetics, (2) model extension to irregular geometries, and (3) flows around seamounts. In the first area, three models have been developed to study eddy-meanflow energetics in ocean circulation. The formulation of these models is unique and it is felt that they are the first truly applicable to regional energetics. Similarly, NORDA modeling capabilities have been considerably extended by permitting the modelling of irregular ocean basins. This extension from simple rectangular geometries has greatly improved the realism of the model and its behavior. The seamount studies are specifically directed at an examination of measured circulation perturbations near a seamount topography and a comparison with predicted patterns. These comparisons provide data on model ability to predict patterns. These comparisons provided data on model ability to predict flow fields and also on the accuracy of predictions. GRA

N81-16713# Synectics Corp., Rome, N. Y.
BATHYMETRIC DATA REDUCTION SYSTEM Final Technical Report, Aug. 1976 - Mar. 1980
Donald T. Alvarez, Joan R. Terenzette, and David A. Kolassa Griffiss AFB, N.Y. RADC Aug. 1980 194 p refs
(Contract F30602-76-C-0412; AF Proj. 4302)
(AD-A091942; CJ-0756-A; RADC-TR-80-273) Avail: NTIS HC A09/MF A01 CSCL 08/10

This report describes the development of the bathymetric data reduction system. It addresses mathematical areas (projection transformations and their inverses, fathogram processing and geographic sectioning) data accuracy considerations (registration and data manipulation), software accomplishments (digitizing, batch processing and data base) and software/hardware configuration. This report contains appendices detailing terms used, loadlines and file and record formats. GRA

N81-16714# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
DETERMINATION OF THE GENERAL CIRCULATION OF THE OCEAN AND THE MARINE GEOID USING SATELLITE ALTIMETRY Final Report, 1 Jan. - 31 Dec. 1980
Carl Wunsch 1 Dec. 1980 9 p refs
(Contract N00014-80-C-0273; NR Proj. 083-157)
(AD-A092755) Avail: NTIS HC A02/MF A01 CSCL 08/3

This contract was the continuation of a previous one for the general purpose of understanding the use of satellite altimetry in physical oceanography. There have been several activities, some of which are continuing. We have published a paper demonstrating a general formalism for using altimetry for the joint purpose of determining the general circulation of the oceans and improving the geoid. Using conventional hydrography in the North Atlantic Ocean, a sea surface relative to the geoid has been constructed and will soon be published. The general problem of constructing marine geoids independent of altimetric measurements has been solved in the context of inverse theory. Such geoids are required for subtraction from an altimetric surface to find the ocean current signal. Finally, the principal investigator has been involved in the active planning for a proposed new altimetric mission called TOPEX. GRA

N81-16715 North Carolina State Univ. at Raleigh.
CONTINENTAL SHELF CIRCULATION INDUCED BY MOVING, LOCALIZED WIND STRESS Ph.D. Thesis
John Michael Klinck, II 1980 139 p
Avail: Univ. Microfilms Order No. 8100790

The circulation in a stratified, F-plane continental shelf induced by a moving wind stress is investigated through three analytical models. In all cases, the shelf has a flat bottom and vertical coastal wall. The passage of a storm leaves behind a steady, geostrophically balanced alongshore velocity. For a cross-shelf wind pulse, the flow is uniform with depth and there is a little distortion of the internal density field. A noticeable slope in the density field results in cases forced by an alongshore wind stress and the alongshore velocity is vertically sheared, due to the thermal wind balance. The calculated model results compare favorably with current meter records obtained during a cold front passage off Charleston, South Carolina. Dissert. Abstr.

N81-16716 Washington Univ., Seattle.
FINITE ELEMENT COMPUTATION OF BAROTROPIC TIDAL MOTIONS IN DEEP ESTUARIES Ph.D. Thesis
Bruno M. Jamart 1980 158 p
Avail: Univ. Microfilms Order No. 8029765

Tidal motion in semi-enclosed basins is essentially periodic. Hence, the solution of the shallow water wave equations in Fourier space can be an efficient alternative to the conventional time stepping procedures. A numerical method based on that premise is described; the method combines variational calculus, an iterative scheme and the finite element method to determine the spatial variations of the Fourier coefficients of water height and depth averaged horizontal velocities. The elimination of the velocities from the continuity equation, either analytically or in an iterative procedure, yields a Helmholtz type partial differential equation for the free surface elevation. A simplified version of the procedure is applied to Knight Inlet, British Columbia, a long, deep, narrow, steep-sided fjord. The extraction of tidal energy through internal mechanisms associated with the flow over the sill is represented by a body force proportional to the depth mean velocity divided by the local time mean depth. Computed results for the semi-diurnal barotropic tidal flow agree fairly well with all available observations. An attempt to solve the same problem with a conventional time stepping procedure demonstrates the efficiency of the harmonic approach. Dissert. Abstr.

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N81-16717 California Univ., Berkeley.
NEUROENDOCRINE STRATEGIES FOR ADAPTATION TO

HIGH ALTITUDE Ph.D. Thesis
Susan Fong Akana 1980 145 p
Avail: Univ. Microfilms Order No. 8029309

Some of the neuroendocrine adaptations which occur in rats after exposure to high altitude are addressed, particularly the responses of the adrenal cortex and their relation to certain aspects of central and peripheral neurotransmitter metabolism. Whether the enhancement of tyrosine hydroxylase activity which occurs in rats at high altitude in select regions of the brain and in the adrenal gland is induced by high levels of corticosterone was experimentally investigated. Major results confirm an increase in tyrosine hydroxylase in the brain and adrenal gland and an increase in corticosterone levels in the juvenile rat developing at high altitude as compared to the young sea level controls. When the adrenocortical function was depressed by administration of metyrapone, both at sea level and high altitude, tyrosine hydroxylase activity remained unchanged. It is suggested from the data that the increase in adrenocortical function and the increase in tyrosine hydroxylase activity in brain and adrenal gland of rats born and maintained at high altitude are two ir Jependent adapations to the hypoxic environment.
Dissert. Abstr.

N81-16718*# National Aeronautics and Space Administration, Washington, D. C.
LIFE OF THE ONION NOT KNOWING UP FROM DOWN
A. Gordeyev Aug. 1980 9 p refs Transl. into ENGLISH from Znaiye - Sila, (USSR), v. 12, no. 630, Dec. 1979 p 9-10 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-3199)
(NASA-TM-76353) Avail: NTIS HC A02/MF A01 CSCL 06C

The absence of the force of gravity has a negative effect on plant life. Plants grown on spacecraft have died prematurely. Tests are being made to discover whether or not electricity will compensate for the absence of gravitation. It was found that an onion under current is not subject to the force of gravity. Tremendous possibilities are opened up by these experiments.
Author

N81-16719*# National Aeronautics and Space Administration, Washington, D. C.
HEMORHEOLOGICAL CHANGES, THE STATE OF MICROCIRCULATION, AND BLOOD ACID-BASE BALANCE IN RATS UNDER CONDITIONS OF A 30-DAY LIMITING OF THE MOTOR ACTIVITY
Yu. M. Shtykhno and V. I. Udovichenko Dec. 1980 8 p refs Transl. into ENGLISH from Vestn. Akad. Med. Nauk, SSSR (USSR), no. 2, 1978 p 68-71 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Inst. of General Pathology and Pathological Physiology of the Akademii Meditsinskikh Nauk, Moscow
(Contract NASw-3198)
(NASA-TM-76464) Avail: NTIS HC A02/MF A01 CSCL 06S

Changes were expressed in reduction in number of true capillaries, the appearance of nonfunctioning empty vessels and in the opening of the arteriolo-venular shunts. Changes in the acid-base balance in the direction of reduction of buffer blood content were also noted.
T.M.

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N81-16720 Utah Univ., Salt Lake City.
CARDIORESPIRATORY AND PERCEPTUAL RECOVERY FROM A MARATHON RUN BY NOVICE AND EXPERIENCED WOMEN MARATHON RUNNERS Ph.D. Thesis
Carol Lynette Christensen 1980 133 p
Avail: Univ. Microfilms Order No. 8101001

Subjects performed tests of maximum oxygen consumption (VO2max), 7-9 days before, and 15-16 days after a marathon. They also completed four 30 minute runs on the treadmill at their planned race pace, 6-7 days before, and 2-3 days, 6-7 days, and 13-14 days after the marathon. The five novice and eight experienced women marathon runners who served as subjects in the second experiment, performed VO2max tests 8-11 days before, and 7-9 days after a marathon held approximately 5 months after the first experiment. Cardiorespiratory and perceptual parameters do not appear to be decremented by a marathon run nor does marathon running experience appear to affect the time-course of recovery of these parameters. Other factors, such as stiffness, soreness, motivation, and biochemical indices may recover more slowly, but are apparently not reflected in the gross metabolic response to exercise or feelings of exertion following a marathon run.
Dissert. Abstr.

N81-16721 Washington Univ., Seattle.
PRESSURE-FLOW HYSTERESIS IN THE PULMONARY VASCULATURE Ph.D. Thesis
Kenneth Charles Beck 1980 94 p
Avail: Univ. Microfilms Order No. 8029733

Pulmonary vessels are composed of soft tissue that contains smooth muscle, and are embedded in the soft tissue of lung parenchyma. Both vascular tissue and pulmonary parenchyma were shown to be hysteretical, i.e., the tissues do not have a unique length-tension or pressure-volume relationship, their mechanical properties depending strongly on stress history. Therefore, the pulmonary vascular bed as a whole should not have a unique pressure-volume relationship. Furthermore, vascular resistance should also be history-dependent, in a way that ought to parallel pressure-volume hysteresis. Pressure-flow hysteresis was studied by fixing outflow pressure (P sub pv) and cycling flow (Q) while measuring inflow pressure (P sub pa) and fixing Q and cycling P sub pv while measuring P sub pa. Vascular volume changes were estimated from changes in the perfusion circuit reservoir.
Dissert. Abstr.

N81-16722*# National Aeronautics and Space Administration, Washington, D. C.
ANTIBODIES TO MYOFIBRIL ANTIGENS IN COSMONAUTS AFTER SPACEFLIGHTS
R. Yu. Tashpulatov, T. A. Danilova, A. T. Lesnyak, V. I. Legenkov, V. S. Znamenskiy, and Ye. Yu. Dedyuyeva Aug. 1980 8 p refs Transl. into ENGLISH from Zh. Mikrobiol. Epidemiol. Immunobiol. (USSR), no. 12, Dec. 1979 p 36-39 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Moscow Gamalei Inst. for Epidemiology and Microbiol.
(Contract NASw-3199)
(NASA-TM-76300) Avail: NTIS HC A02/MF A01 CSCL 06P

Serum samples obtained from 15 astronauts before and after spaceflights were studied with the use of the indirect immunofluorescent method. In seven astronauts antibodies to different elements of the human heart muscle appeared after flights. Strong and very strong luminescence of the elements of heart muscle tissue was detected in the astronauts after the third space flight. In a study of the sera on sections of bovine heart muscle tissue the reactions of the sera taken before and after flight were found to show no essential differences. E.D.K.

N81-16723*# National Aeronautics and Space Administration, Washington, D. C.
WAYS OF INCREASING MUSCULAR ACTIVITY BY MEANS OF ISOMETRIC MUSCULAR EXERTION
A. V. Kovalik Aug. 1980 9 p refs Transl. into ENGLISH from Teor. i Prakt. Fizicheskoy Kultury (USSR), no. 12, Dec. 1979 p 38-40 Transl. by Kanner (Leo) Associated, Redwood City, Calif. Original doc. prep. by Penza Factory Higher to Technical Inst., USSR
(Contract NASw-3199)
(NASA-TM-76307) Avail: NTIS HC A02/MF A01 CSCL 06P

The effect of isometric muscular exertion on the human body was investigated by having subjects perform basic movements in a sitting position in the conventional manner with additional muscle tension at 50% maximum force and at maximum force. The pulse, arterial pressure, skin temperature, respiratory rate, minute respiratory volume and electrical activity of the muscles

involved were all measured. Performance of the exercises with maximum muscular exertion for 20 sec and without movement resulted in the greatest shifts in these indices; in the conventional manner substantial changes did not occur; and with isometric muscular exertion with 50% maximum force with and without movement, optimal functional shifts resulted. The latter is recommended for use in industrial exercises for the prevention of hypodynamia. Ten exercises are suggested. E.D.K.

N81-16724*# National Aeronautics and Space Administration, Washington, D. C.

PHARMACOLOGICAL ACTIVITY AND TOXICITY OF SOME NEUROTROPIC AGENTS UNDER CONDITIONS OF EXPERIMENTAL HYPODYNAMIA

L. T. Kirichek Sep. 1980 8 p refs Transl. into ENGLISH from Farmakol. Toksikol. (USSR), v. 42, no. 3, May - Jun. 1979 p 221-225 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Kharkov Medical Inst. (USSR)
(Contract NASw-3199)
(NASA-TM-76371) Avail: NTIS HC A02/MF A01 CSCL 06T

The indices of pharmacological range, risk coefficients, ED50, LD50, the size of the area of toxic activity, and maximal tolerated and absolute lethal doses were compared in hypodynamic mice. The pharmacological activity of the test neurotropic agents exhibiting a central action underwent change, but their toxicity remained unchanged. T.M.

N81-16725*# National Aeronautics and Space Administration, Washington, D. C.

AUTOREGULATION OF CEREBRAL BLOOD CIRCULATION UNDER ORTHOSTATIC TESTS

M. D. Gayevyy, V. G. Maltsev, and V. E. Pogorelyy Sep. 1980 10 p refs Transl. into ENGLISH from Fiz. Zh. SSR (USSR), v. 65, no. 2, 1979 p 263-268 Original language document announced as A79-36098 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Pyatogorsk Pharmaceutical Inst., USSR
(Contract NASw-3199)
(NASA-TM-76372) Avail: NTIS HC A02/MF A01 CSCL 06P

Autoregulation of cerebral blood flow (ACBF) under orthostatic tests (OT) was estimated in acute experiments on rabbits and cats under local anesthesia according to changes of perfusion pressure (PP) in carotid arteries, cerebral blood flow, pressure in the venous system of the brain, and resistance of cerebral vessels. The OT were conducted by turning a special table with the animal fastened to it from a horizontal to a vertical (head up or head down) position at 40 to 80 deg. In most experiments ACBF correlated with the changes of PP. Different variations of ACBF and its possible mechanisms are discussed. E.D.K.

N81-16726*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF CERVICOLABYRINTHINE IMPULSATION ON THE SPINAL REFLEX APPARATUS

A. I. Yarotskiy Sep. 1980 7 p refs Transl. into ENGLISH of Fiziol. Zh. SSSR (USSR), v. 75, no. 12, Dec. 1979 p 1838-1840 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Uzbek Inst. for Physical Culture, Tashkent, USSR
(Contract NASw-3199)
(NASA-TM-76375) Avail: NTIS HC A02/MF A01 CSCL 06P

In view of the fact that the convergence effect of vestibular impulsation may both stimulate and inhibit intra and intersystemic coordination of physiological processes, an attempt was made to define the physiological effect on the spinal reflex apparatus of the convergence of cervicolabyrinthine impulsation on a model of the unconditioned motor reflex as a mechanism of the common final pathway conditioning the formation and realization of a focused beneficial result of human motor activities. More than 100 persons subjected to rolling effect and angular acceleration during complexly coordinated muscular loading were divided according to typical variants of the functional structure of the patella reflex in an experiment requiring 30 rapid counterclockwise head revolutions at 2/sec with synchronous recording of a 20 item series of patella reflex acts. A knee jerk coefficient was used in calculations. In 85 percent of the cases 2 patellar reflexograms show typical braking and release of knee reflex and 1 shows an extreme local variant. The diagnostic and prognostic value of these tests is suggested for determining adaptive possibilities of functional systems in respect to acceleration and proprioceptive stimuli. T.M.

N81-16727*# National Aeronautics and Space Administration, Washington, D. C.

RHEOENCEPHALOGRAPHY IN MENIERE'S DISEASE

M. P. Nikolayev and O. N. Mertsalova Sep. 1980 7 p refs Transl. into ENGLISH from Vestn. Otorinol-Laringol. (USSR), no. 3, May-Jun. 1979 p 12-15 Transl. by Kanner (Leo) Associated, Redwood City, Calif. Original doc. prep. by Botkin Clinical Hospital
(Contract NASw-3199)
(NASA-TM-76387) Avail: NTIS HC A02/MF A01 CSCL 06E

Rheoencephalography (REG) was used on 35 patients with Meniere's disease to determine tonus and perfusion of cerebral vessels. The analysis took account of age, duration of the disease and presence or absence of cervical osteochondrosis. Hypertensive symptoms in the vertebro-basilar system predominated in the under 45 age group, while for the over 45 patients and those suffering for more than 5 years, hypertensive symptoms were likewise noted in the internal carotid arterial system. Signs of angiospasm were revealed both for patients with cervical osteochondrosis and without it. Hypertensive signs were noted in 88.5% of patients with Meniere's disease and as a rule they were noted in the entire vertebro-basilar system without respect to the presence or absence of concurrent cervical osteochondrosis and uni- or bilateral affection of the labyrinth; in patients over 45 who had suffered more than 5 years this also applied to the internal carotid arterial system. Identification of the condition of cerebral circulation and the planning of more effective therapy that influences vascular tone is made possible by REG. E.D.K.

N81-16728*# National Aeronautics and Space Administration, Washington, D. C.

HYDROELASTIC EFFECTS IN THE AORTA BIFURCATION ZONE

A. S. Volmir, M. S. Gersheyn, and B. A. Purinya Oct. 1980 7 p refs Transl. into ENGLISH of Mekh. Polim. (USSR), v. 7, Jan. - Feb. 1971 p 164-165 Original language document announced as A71-28657 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. Prep. by Latvian SSR Acad. of Sci., USSR
(Contract NASw-3199)
(NASA-TM-75432) Avail: NTIS HC A02/MF A01 CSCL 06P

The mechanical behavior of the vessels and blood is mathematically analyzed at the point of aortic bifurcation using a homogeneous single layer channel as a model of the aorta. Allowance is made for the fact that the aortic intima is considerabley less rigid than the other layers. For analysis of blood flow in the major arteries, the blood is treated as a viscous Newtonian fluid whose movements are described by Navier-Stokes equations and a continuity equation. Blood flow dynamics at the aortic bifurcation are discussed on the basis of the results. E.D.K.

N81-16729*# National Aeronautics and Space Administration, Washington, D. C.

ORTHOSTATIC HYPOTENSION

J. J. Grimm Dec. 1980 11 p refs Transl. into ENGLISH of Rev. Suisse de Medecine (Switzerland), 69, no. 16, 1980 p 518-521 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Univ. Med. Policlinic, Lausanne, Switzerland
(Contract NASw-3199)
(NASA-TM-75433) Avail: NTIS HC A02/MF A01 CSCL 06S

Following a brief physiopathological review, orthostatic hypotension is classified into three groups: organic, functional and medication-dependent. The importance of etiological diagnosis, the use of objective tests and appropriate therapy, especially concerning the organic forms, is stressed. Author

N81-16730*# National Aeronautics and Space Administration, Washington, D. C.
DOSIMETRIC INVESTIGATIONS OF COSMIC RADIATION ABOARD THE KOSMOS-936 AES (JOINT SOVIET-AMERICAN EXPERIMENT K-206)
E. V. Benton, Ye. Ye. Kovalyev, and V. Ye. Dudkin Apr. 1980 90 p refs Transl. into ENGLISH of "Dozimetricheskiye Issledovaniya Kosmicheskikh Izlucheniy na Bortu ISZ Kosmos-936 (Sovmestnyy Sovetsko-Amerikanskiy Eksperiment K-206)" Moscow, 1979 124 p Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. of Midico-Biological Problems, Ministry of Health, Moscow
(Contract NASw-3199)
(NASA-TM-75772) Avail: NTIS HC A05/MF A01 CSCL 06R

The Soviet and American parts of the experiment are described separately. Particular attention was given to the following problems: placement of the detectors; study of neutron radiation within the biosatellite; and studies of fragmentation of heavy nuclei on accelerators. Unified methods were developed for the calibration of Soviet and American detectors. T.M.

N81-16731*# Tennessee Univ., Memphis.
RELATIVE TOXICITY TESTING OF SPACECRAFT MATERIALS. 1: SPACECRAFT MATERIALS Annual Report, 10 Nov. 1978 - 9 Nov. 1980
W. H. Lawrence 6 Nov. 1980 83 p refs
(Contract NAS9-15670)
(NASA-CR-160908) Avail: NTIS HC A05/MF A01 CSCL 06T

In chamber thermodegradation procedures were used to access the lethality to rats of the pyrolysis/combustion products of three foams, an adhesive backed metallic tape and RTV silicone rubber adhesive sealant used in spacecraft construction. The role of carbon monoxide in the overall pyrolysate toxicity was also investigated. Post exposure observation of the rats, histological evaluation of selected organs, carbon monoxide concentration in the chamber atmosphere during exposure and the percent carboxyhemoglobin in the animals expiring in the chamber are discussed. Thermogravimetric analysis and dosage response results are given. The lethal effect of the RTV silicon appears to be due to physical obstruction of the respiratory system by particulate matter from pyrolysis. A.R.H.

N81-16732*# Tennessee Univ., Memphis.
RELATIVE TOXICITY TESTING OF SPACECRAFT MATERIALS. 2: AIRCRAFT MATERIALS Annual Report, 10 Nov. 1978 - 9 Nov. 1980
W. H. Lawrence 6 Nov. 1980 111 p refs
(Contract NAS9-15670)
(NASA-CR-160907) Avail: NTIS HC A06/MF A01 CSCL 06T

The relative toxicity of thermodegradation (pyrolysis/combustion) products of aircraft materials was studied. Two approaches were taken to assess the biological activity of the pyrolysis/combustion products of these materials: (1) determine the acute lethality to rats from inhalation of these pyrolysates and (2) examine the tendency for sublethal exposure to the pyrolysates to disrupt behavioral (shock avoidance) performance of exposed rats. The ralative importance of lethality vs. behavioral effects in selection of a material may be dictated by whether or not individuals potentially exposed to such products, would have an opportunity to escape if they were behaviorally capable of doing so. If so, the second parameter would assume greater importance, but if not the first parameter may be of much greater importance in selecting materials. E.D.K.

N81-16733# McDonnell-Douglas Astronautics Co., St. Louis, Mo. Engineering Psychology Dept.
DYNAMIC TARGET ACQUISITON: EMPIRICAL MODELS OF OPERATOR PERFORMANCE Final Report, Jul. 1977 - Jun. 1980
Larry R. Beideman, Frank E. Gomer, and Sheldon H. Levine Aug. 1980 221 p refs
(Contract F49620-77-C-0100; AF Proj. 2313)
(AD-A092263; MDC-E2305; AFOSR-80-1177TR) Avail: NTIS HC A10/MF A01 CSCL 17/8

The intent of this three year research program has been to evaluate detection and recognition processes as observers view dynamic sensor imagery for target acquisition purposes. Moreover, we have attempted to specify differences in human performance which can be attributed to inherent differences between IR and TV target signatures. In all experiments, we have emulated the image dynamics associated with a ground-stabilized, narrow FOV sensor. Further, we have used experienced observers as subjects in these experiments. The operational characteristics of certain attack aircraft and imaging missiles led us to examine initial slant ranges to target of 30,000, 15,000, and 5,000 ft. Comparisons of operator performance with simulated IR vs. TV imagery at all initial slant ranges indicated that IR targets were detected more quickly and at greater stand-off ranges than comparable TV targets, especially when targets were embedded in background scenes of medium or high complexity. This occurred even though we simulated optimal visibility conditions, with no significant atmospheric attenuation or distortion of the energy received by the imaging sensor. GRA

N81-16734# Civil Aeromedical Inst., Oklahoma City, Okla.
EFFECTS OF OZONE (0.30 PARTS PER MILLION, APPROXIMATELY 600 MU G/M 3) ON SEDENTARY MEN REPRESENTATIVE OF AIRLINE PASSENGERS AND COCKPIT CREWMEMBERS
E. A. Higgins, M. T. Lategola, C. E. Melton, and J. A. Vaughan Mar. 1980 54 p refs
(AD-A092268; FAA-AM-80-9) Avail: NTIS HC A04/MF A01 CSCL 01/2

This study was undertaken to determine the effects of 0.30 ppmv ozone on 40 men representative of airline pilots. All were medically fit; 20 were smokers and 20 were nonsmokers. Subjects were divided into two age groups, 40-49 years and 50-59 years. The experiments consisted of exposure to 0.30 ppmv ozone and, on another occasion, to air only for 3 h at a simulated altitude of 6,000 ft mean sea level. Subjects were sedentary throughout the experiment. Ozone had no effect on heart rate and short-term memory. The group showed a statistically significant incidence of symptoms related to ozone exposure; most were shown by the 40 to 49 year old nonsmoking group while at altitude and postaltitude, and in smokers in the 50 to 59 year age group only at altitude. Eye irritation was the commonest symptom, followed by headache, nasal irritation, and throat irritation. Data showed significant effects of ozone on forced expiratory volume, 1 second forced expiratory volume, and forced end-expiratory flow. The pulmonary effect of ozone appears to be principally on the small airways. Impairment of visual accommodation was associated with ozone. Dark adaptation threshold was elevated in ozone in the 50 to 59 year nonsmoking age group. Retinal bleach recovery time was retarded and blink rate was higher during ozone exposure. It is concluded that 0.30 ppmv ozone is near threshold for adverse effects of ozone. The data are also applicable to passengers who fit into the same category as these sedentary subjects. GRA

N81-16735# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
EVALUATION OF SIMULATED RADIOFREQUENCY HEATING PROCEDURES Interim Report, 1 Jul. 1978 - 1 Jun. 1979
John C. Burr, Jerome H. Krupp, Doris A. Hamill, and Mary E. Donahue Oct. 1980 28 p refs
(AF Proj. 7757)
(AD-A092731; SAM-TR-80-30) Avail: NTIS HC A03/MF A01 CSCL 06/16

A method for simulating radiofrequency radiation (RFR) heating at 1.2 GHz E-field oriented in the rat using warm moist (90% relative humidity) air is presented. The method can adequately simulate the overall linear rate of internal heating in the rate and the peak temperature excursion but fails to simulate the initial rapid rate of temperature rise due to RFR. Even with this shortcoming it appears that this moist heat simulation is superior to previous hot air simulations. GRA

N81-16736# New York Univ., N. Y. Neuromagnetism Lab.
MAGNETIC FIELDS OF THE CEREBRAL CORTEX
Samuel J. Williamson and Lloyd Kaufman 15 Jun. 1980 51 p refs Submitted for publication
(Contract N00014-76-C-0568; NR Proj. 201-209)

(AD-A086288; Rept-6) Avail: NTIS HC A04/MF A01 CSCL 06/16

The observed patterns over the scalp of magnetic fields evoked by visual, somatic, and auditory stimuli are analyzed to deduce the position and depth of the equivalent current dipole generating source. Expressions are developed for both sphere and half space models for the head, and graphs are presented to correct for the use of a pickup coil of finite diameter. For all three responses, the position of the generating source is deduced to lie in the corresponding primary projection area of the cortex. GRA

N81-16737# Saint Elizabeth's Hospital, Brighton, Mass.
DEVELOPMENT OF PERCUTANEOUS ENERGY TRANSMISSION SYSTEMS Annual Progress Report, Apr. 1979 - Mar. 1980
Benedict D. T. Daly, Michael Szycher, Michael Worthington, Victor L. Poirier, Roger G. Warren, Christian C. Haudenschild, Michael B. Lewis, Charles E. Scheller, Jon N. Meliones, and Donald Dempsey 11 Jun. 1980 290 p refs
(Contract N01-HV-8-2919)
(PB81-109381; NIH-N01-HV-8-2919-2) Avail: NTIS HC A13/MF A01 CSCL 06B

A system designed to transmit energy to intracorporeal blood pumps was developed. This system utilized polytetrafluroethylene (PTFE) to provide a connective tissue biomaterial seal limiting epidermal migration and sinus formation. Eight iterations were evaluated in vivo. These studies have demonstrated that PTFE will support ingrowth and that this ingrowth limits epidermal migration. The interface is protected by a polyester velour covered skirt which provides strain relief and this must be implanted subdermally. Mobility of the tissues surrounding the device is important to allow displacement which provides additional strain relief. A semiquantitative swab culture technique predicts incipient infection. Nutritional deprivation adversely affects biomaterial tissue interactions. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N81-16738# California Univ., San Diego. Center for Human Information Processing.
ERRORS IN HUMAN PERFORMANCE Final Report, 1 Jun. 1979 - 31 May 1980
Donald A. Norman 15 Aug. 1980 50 p refs
(Contract N00014-79-C-0515; ARPA Order 3767; NR Proj. 157-434)
(AD-A091925; Rept-8004) Avail: NTIS HC A03/MF A01 CSCL 05/8

Work on this contract examined various applications of human information processing, focusing on the analysis of human error. As a result of the contract investigations, several areas of potential application were identified. One area of immediate possible application is in the design of human-machine interfaces, with particular concern for aspects of system design that lead to human error, taking into account what is known about human attentional and short-term memory limitations. The major focus of the research effort was devoted to the study of human error, especially those made by highly skilled operators in complex, high-demand systems. A classification scheme for these errors was developed. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N81-16739# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
TECHNICAL EVALUATION REPORT OF THE AEROSPACE MEDICAL PANEL WORKING GROUP WG-08 ON EVALUATION OF METHODS TO ASSESS WORKLOAD
Bryce O. Hartman (USAF School of Aerospace Medicine, Brooks AFB, Tex.) Nov. 1980 21 p
(AGARD-AR-139; ISBN-92-835-1374-6) Avail: NTIS HC A02/MF A01

Military aircraft are becoming increasingly complex the associated avionics systems more sophisticaed and the mission profiles more demanding. The problem is to establish if such an increase in aircrew workload has become a limiting factor in the operational employment of some aircraft and to select viable methods to assess it. This companion document to 'Survey of Methods to Assess Workload' sets forth conclusions on workload measurement methodology. S.F.

N81-16740*# Acurex Corp., Mountain View, Calif. Aerospace Systems Div.
FURTHER STUDY FOR FABRICATION, EVALUATION, AND TESTING OF MONOLAYER WOVEN MATERIALS FOR SPACE SUIT INSULATION Final Report
Robert Short Sep. 1980 12 p
(Contract NAS2-10542; Acurex Proj. 6246)
(NASA-CR-166140; ACUREX-TR-80-31/AS) Avail: NTIS HC A02/MF A01 CSCL 06K

Improvements to the monolayer woven pile concept were evaluated in terms of increased durability and thermal performance. Three varieties of the monolayer material were tested for thermal conductance under various conditions simulating those which occur in space. In addition, the tendency of the pile to unravel was subjectively evaluated. E.D.K.

N81-16741*# Vought Corp., Dallas, Tex.
DEVELOPMENT AND FABRICATION OF AN ADVANCED LIQUID COOLING GARMENT Final Report
C. W. Hixon 6 Mar. 1978 87 p
(Contract NAS2-9026)
(NASA-CR-152101; Rept-2-53200/8R-3462) Avail: NTIS HC A05/MF A01 CSCL 06G

A tube/fin concept liquid cooling garment head cooler was developed, fabricated and delivered to NASA-ARC. The head cooler was fabricated from polyurethane film which sandwiches the transport fluid tubing and a thermally conductive fin material. The head cooler garment is sewn to form a skull cap and covered with a comfort liner. In addition, two Neonate heating garments were fabricated and supplied to NASA for further finishing and use in medical tests. The resulting garment is flexible, elastic and conforms to the head comfortably. Tests on a tube/fin element of identical construction as the head cooler demonstrated good thermal effectiveness. Use of commercially available materials and development of relatively simple fabrication techniques give the potential for a low garment cost. Author

N81-16742# Boeing Aerospace Co., Seattle, Wash. Engineering Technology Div.
NAVY MANAGER'S GUIDE FOR THE DESIGN SECTIONS OF MIL-H-46855 Final Report, 27 Sep. 1979 - 26 Sep. 1980
Mildred English 26 Sep. 1980 70 p refs
(Contract N62269-79-R-0740)
(AD-A092009; D180-26111-1; NADC-79219-60) Avail: NTIS HC A04/MF A01 CSCL 05/5

This document explains how to implement the design sections of MIL-H-46855, Human Engineering Requirements for Military Systems, Equipment and Facilities. It was written for Navy and contractor Human Factors Engineering (HFE) managers. DoD and Navy requirements for performing HFE design during system acquisition are cited. Eight standard HFE design techniques and 9 design techniques using computers are described. When and how techniques are used, their products and purpose, and advantages and limitations are explained. GRA

N81-16743# Virginia Polytechnic Inst. and State Univ., Blacksburg. Human Factors Lab.
HUMAN VISUAL PERFORMANCE AND FLAT PANEL DISPLAY IMAGE QUALITY
Harry L. Snyder Jul. 1980 463 p refs
(Contract N00014-78-C-0238; NR Proj. 196-155)
(AD-A092685; VPI-HFL-80-1/ONR-80-1) Avail: NTIS

HC A20/MF A01 CSCL 05/5

This is the Final Technical Report of Task I: Human Engineering Survey and Analysis of the subject contract. The task is a survey of the pertinent visual performance, display system capability, and human engineering design requirements for flat panel visual displays, as applied to U.S. Navy Airborne, Shipborne, and Land-Based Systems. The report contains two application examples of the selection of flat panel displays for both airborne and ship-based information systems. It also surveys the current state-of-the-art of flat panel display technologies, and the manner by which existing visual performance and theory can be applied to the selection and evaluation of flat panel technologies for various applications. The flat panel technologies surveyed are light emitting diodes, electroluminescence, liquid crystal, electrochromic, electrophoretic, and gas (plasma) discharge. A uniform set of performance variables is used to compare the various technologies, both among themselves and with the traditional cathode ray tube. Similarly, these technologies are evaluated against design criteria and current models of image quality which relate human performance to display characteristics. Pertinent human visual performance data are presented as the basis for selecting and applying image quality models. Data gaps and needs are summarized at the end of the report. GRA

N81-16744# Massachusetts Inst. of Tech., Cambridge. Sea Grant Coll. Program.

AN ASSESSMENT OF UNDERSEA TELEOPERATORS

Thomas Nico Sofyanos and Thomas B. Sheridan Jun. 1980 316 p refs

(Grant NOAA-79AA-D-00101)

(PB81-102535; MITSG-80-11; NOAA-80082504) Avail: NTIS HC A14/MF A01 CSCL 13J

The current and near future applications of undersea teleoperators and competing modes of underwater intervention are assessed. It identifies the role of remotely operated vehicle systems and the implications on diving safety and underwater inspection of offshore installations. The current development trends for teleoperator systems are examined and federally supported programs are evaluated. GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N81-16745# Maryland Univ., College Park. Dept. of Computer Science.

DIGITAL AND CELLULAR CONVEXITY Interim Report

Chul E. Kim and Jack Sklansky Sep. 1980 35 p refs Sponsored in part by the National Inst. of General Medical Sciences (Grants AF-AFOSR-3271-77; NSF MCS-78-22313; AF Proj. 2304)

(AD-A092786; TR-951; AFOSR-80-1198TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

A new definition of cellular convexity is introduced. It is shown that given a complex, it is cellularly convex if and only if the digital region determined by the complex is digitally convex. It is also shown that a digital region (a complex) is digitally (cellularly) convex if and only if the MPP of the digital region (the half-cell expansion of the complex) contains only the digital region (the centers of the cells of complex). An algorithm is presented for determining the concavity tree of a digital region or a complex. GRA

N81-16746# Naval Postgraduate School, Monterey, Calif.

DESIGN OF A SYSTEM INITIALIZATION MECHANISM FOR A MULTIPLE MICROCOMPUTER M.S. Thesis

John Lee Ross Jun. 1980 102 p refs

(AD-A092137) Avail: NTIS HC A06/MF A01 CSCL 09/2

This thesis presents a design for a system initialization mechanism for a multiple processor system. The design is based upon a system of microprocessors (specifically the Intel 8086) being used with a set of application processes, as is common in many real time applications. The design is based upon the concepts of explicit communicating processes and explicit memory segmentation - although it does not require full hardware segmentation. With the goal of simplifying the system initialization function, this thesis segregates the required initialization actions into three distinct phases. The specific phase for each action is determined by which phase provides the most supportive environment for that particular action. While the initialization mechanism described in this thesis was developed for a particular real-time application, the design concepts described are applicable to a variety of hardware and operating system configurations. GRA

N81-16747# Naval Postgraduate School, Monterey, Calif.

DYNAMIC LINKING IN A MICROCOMPUTER ENVIRONMENT M.S. Thesis

Gerald Bertram Blanton Sep. 1980 249 p refs

(AD-A092404) Avail: NTIS HC A11/MF A01 CSCL 09/2

This thesis presents the detailed design for a dynamic linker suitable for microcomputer operation. The design exhibits the usual property of dynamic linking in that the binding of interprocedure symbolic references to virtual addresses is deferred until the symbolic reference is first encountered during process execution. The design includes the specifications of dynamic linker modules and data structures. Furthermore, an overview of necessary operating system support is presented along with a detailed discussion of all additional translator output required. Hardware features desirable (but not necessary) in a dynamic linking environment are reviewed. Dynamic linking without translator support and unlinking of an object (from a process address space) are investigated. A subset of the dynamic linker design (not including the unlinking capability) was implemented on an Intel 8080 microprocessor as a demonstration of the feasibility of the concepts introduced. GRA

N81-16748# Air Force Weapons Lab., Kirtland AFB, N. Mex.

RADIATION EVALUATION OF THE AM2901A MICROPROCESSOR Final Report

Bernd Deve Aug. 1980 66 p refs Sponsored in part by the Defense Nuclear Agency

(AD-A092415; AD-E200606; AFWL-TR-80-19) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes the development of a program to perform a radiation evaluation and error analysis of the AM2901A bit-slice microprocessor. The integrated circuit (IC) manufacturer's functional and dynamic test sets were obtained and rewritten using algorithmic pattern generation programming techniques to run on an in-house MD-104 tester. The test procedure and radiation evaluation of the microprocessor are presented. The devices were tested in neutron, total gamma dose, and transient ionizing dose-rate environments. GRA

N81-16749# Electronics Research Lab., Adelaide (Australia).

AUTOMATIC ERASURE OF RELEASED DISK SPACE ON AN IBM 370 COMPUTER USING THE MVS OPERATING SYSTEM

J. C. Gwatking Jun. 1980 43 p refs
(AD-A091957; ERL-0143-TR; AR-002-005) Copyright. Avail: NTIS HC A03/MF A01 CSCL 09/2

The standard MVS operating system supplied for use on IBM 370 computers does not erase or protect data residing on areas of disk that have been released for reuse. This report discusses the problem and describes efficient techniques that have been developed and installed at the DRCS which automatically erase all data when disk space is released by its owner. This has involved modifying the disk space management software and included some restructuring to eliminate contention for system resources while data is erased. GRA

N81-16750# Ohio State Univ., Columbus. Computer and Information Science Research Center.

DESIGN AND ANALYSIS OF RELATIONAL JOINT OPERATIONS OF A DATABASE COMPUTER (DBC)

David K. Hsiao and M. Jaishankar Menon Sep. 1980 96 p refs
(Contract N00014-75-C-0573)
(AD-A092230; OSU-CISRC-TR-80-8) Avail: NTIS HC A05/MF A01 CSCL 09/2

This paper repeats in detail the algorithm earlier employed in the database computer (DBC) in order to perform relational equality joins. Two improvements of the algorithm are proposed herein. The first improvement is achieved by adding a new memory component, called the C-memory, for each processor of the algorithm. The C-memory is used to store the results of the join operation. Also, it is a vital component during the execution of an m-way join operation. The second improvement involves the replacement of a single associative memory (AM) by several smaller associative memories (AMS). Two advantages accrue as a result of this replacement. First, we show that each of the ams needs to operate at a slower rate than the single AM. This implies that we may use random-access memory (RAM) to realize AMS, instead of the true and expensive associative hardware. The second advantage is due to an improvement in the complexity of the join operation when the ams are used. It is shown that the time complexity of the join is linear in the cardinalities of the source, target and result sets (relations). We therefore postulate that no join algorithm can have better time complexity than this. The paper also provides a thorough queueing analysis of the join algorithm as it is carried out in a specialized DBC component known as the post processor. GRA

N81-16751# Naval Postgraduate School, Monterey, Calif. Dept. of Computer Science.

DETAILED DESIGN OF THE KERNEL OF A REAL-TIME MULTIPROCESSOR OPERATING SYSTEM M.S. Thesis

Warren James Wasson Jun. 1980 137 p refs
(AD-A092301) Avail: NTIS HC A07/MF A01 CSCL 09/2

This thesis describes the detailed design of a distributed operating system for a real-time, microcomputer based multiprocessor system. Process structuring and segmented address spaces comprise the central concepts around which this system is built. The system particularly supports applications where processing is partitioned into a set of multiple processes. One such area is that of digital signal processing for which this system has been specifically developed. The operating system is hierarchically structured to logically distribute its functions in each process. This and loop-free properties of the design allow for the physical distribution of system code and data amongst the microcomputers. In a multiprocessor configuration, this physical distribution minimizes system bus contention and lays the foundation for dynamic reconfiguration. GRA

N81-16752# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

CONSIDERATIONS FOR AN ASSEMBLER SCHEDULED MULTI-MICROPROCESSOR SYSTEM M.S. Thesis - Auburn Univ.

Richard Lee Stewart 26 Aug. 1980 118 p refs
(AD-A092216; AFIT-CI-80-41T) Avail: NTIS HC A06/MF A01 CSCL 09/2

A parallel suitability or processability checker was incorporated into pass one of an INTEL 8080 cross assembler. For an assembler level source program, it yields a suitability factor for parallel processing, a jump structure analysis, and the nodes of Ramamoorthy's Loop Free Program Graph shown on the assembly language program source list. Differences in analyzing high level language and assembly language programs are explained. Eight assembly language source programs were analyzed to test the suitability checker and investigate favorable characteristics of assembly language loops with respect to parallel processability. T.M.

N81-16753# Naval Underwater Systems Center, Newport, R. I. Combat Control Systems Dept.

A DISTRIBUTED COMPUTING NETWORK FOR REAL-TIME SYSTEMS

Gordon E. Morrison 3 Nov. 1980 128 p refs
(AD-A092830; NUSC-TD-5932) Avail: NTIS HC A07/MF A01 CSCL 09/2

Partial interconnection, ring, and global bus topologies are examined for use in a real-time distributed computing network. Message lengths and capacity allocation strategies for network links are evaluated in determining system performance based on average message delay. The data suggest a network topology for the application under study. Processor delays at each of the nine nodes in the network are introduced in a simulation model of a global bus network. Thus, link traffic and processor delays are used with message arrival rate, network bandwidth, and processor capacity parameters to arrive at a satisfactory computer system network for a real-time application. A method is developed whereby software requirements are determined in terms of the number of instructions executed. The desired system response time is established and software and hardware specifications may then be defined. GRA

N81-16754# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.

COMPUTER SCIENCE AND TECHNOLOGY: VALIDATING THE CORRECTNESS OF HARDWARE IMPLEMENTATIONS OF THE NBS DATA ENCRYPTION STANDARD Final Report

Jason Gait Sep. 1980 50 p refs
(PB81-113524; NBS-SP-500-20; LC-77-16067) Avail: NTIS HC A03/MF A01 CSCL 09B

The design and operation of the testbed that is used for the validation of hardware implementations of the Federal Information Processing Data Encryption Standard (DES) is described. A particular implementation is verified if it correctly performs a set of 291 test cases that have been defined to exercise every basic element of the algorithm. As a further check on the correctness of the implementation, an extensive Monte Carlo test is performed. The full specification of the DES algorithm, a complete listing of the DES test set and a detailed description of the interface to the test bed are included. GRA

N81-16755# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.

COMPUTER SCIENCE AND TECHNOLOGY: COMPUTER PERFORMANCE EVALUATION USERS GROUP (CPEUG) Final Report

Harold Joseph Highland Oct. 1980 322 p refs Proceedings of the 16th Meeting held at Orlando, Fla., 20-23 Oct. 1980
(PB81-106486; NBS-SP-500-65; LC-80-600155) Avail: NTIS HC A14/MF A01 CSCL 09B

Papers presented at the Sixteenth Meeting of the Computer Performance Evaluation Users Group (CPEUG 80) are recorded. CPEUG 80 focused on new applications that are expected to grow in the 80's and changes that may occur in traditional areas during the 80's. The program was divided into two parallel sessions and included technical papers on previously unpublished work, case studies, tutorials and panels. Technical papers are presented in their entirety. GRA

N81-16756# Electronics Systems, Inc., Acton, Mass.

THE ADAPTATION AND INSTALLATION OF THE RESOURCE ACCESS CONTROL FACILITY (RACF)

J. L. Roughan and J. C. Gwatking Apr. 1980 160 p refs
(PB81-103996; ERL-0136-TR; AR-001-985) Avail: NTIS HC A08/MF A01 CSCL 09B

The Resource Access Control Facility (RACF) is a software package designed to control access by users to a computer

system and to data stored on the system. The modifications and additions to the functions of RACF which were made during its installation in the computing center at the Defense Research Center are described. The RACF is described in sufficient detail to allow the operation of the modifications to be clearly explained. The functions and standards of the computing center are summarized and the actions taken to accommodate users with nonstandard requirements are included. GRA

N81-16757# National Technical Information Service, Springfield, Va.
MINICOMPUTERS. CITATIONS FROM THE NTIS DATA BASE Progress Report, Jul. 1975 - 1978
Brian Carrigan Sep. 1980 257 p
(PB80-814783) Avail: NTIS HC $30.00/MF $30.00 CSCL 09B

A bibliography containing 252 citations is presented which addresses the design and applications of minicomputers. A few of the areas of application include audio recorders, chemical analysis, radiation detection, process control, reactor control, production control, ocean sciences, and tracking systems. Citations include supporting software for solving the problems and processing the data in the many areas of application. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N81-16758* Computer Software Management and Information Center, Athens, Ga.
COSMIC: 1981 CATALOG OF COMPUTER
1981 11 p Sponsored in part by NASA Document includes a microfiche supplement
(NASA-CR-163916) Avail: Issuing Activity CSCL 09B

A catalog listing over 1600 computer programs available from the Computer Software and Management and Information Center is presented. The programs cover several fields including energy technology; chemical, mechanical, and aeronautical engineering; management; and computer technology. Abstracts, a keyword index, and a subject category index are included. In addition, for each program, information on programming languages, machine requirements, program size, and distribution media is given. M.G.

N81-16759*# Intermetrics, Inc., Cambridge, Mass.
HAL/S LANGUAGE SPECIFICATION. VERSION IR-542
1 Sep. 1980 338 p
(Contract NAS9-13864)
(NASA-CR-160910) Avail: NTIS HC A15/MF A01 CSCL 09B

The formal HAL/S language specification is documented with particular referral to the essentials of HAL/S syntax and semantics. The language is intended to satisfy virtually all of the flight software requirements of NASA programs. To achieve this, HAL/S incorporates a wide range of features, including applications oriented data types and organizations, real time control mechanisms, and constructs for systems programming tasks. M.G.

N81-16760*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A USER'S GUIDE FOR DTIZE AN INTERACTIVE DIGITIZING AND GRAPHICAL EDITING COMPUTER PROGRAM
Carolyn C. Thomas Jan. 1981 54 p
(NASA-TM-81919) Avail: NTIS HC A04/MF A01 CSCL 09B

A guide for DTIZE, a two dimensional digitizing program with graphical editing capability, is presented. DTIZE provides the capability to simultaneously create and display a picture on the display screen. Data descriptions may be permanently saved in three different formats. DTIZE creates the picture graphics in the locator mode, thus inputting one coordinate each time the terminator button is pushed. Graphic input devices (GIN) are also used to select function command menu. These menu commands and the program's interactive prompting sequences provide a complete capability for creating, editing, and permanently recording a graphical picture file. DTIZE is written in FORTRAN IV language for the Tektronix 4081 graphic system utilizing the Plot 80 Distributed Graphics Library (DGL) subroutines. The Tektronix 4953/3954 Graphic Tablet with mouse, pen, or joystick are used as graphics input devices to create picture graphics. M.G.

N81-16761# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DIAGNOSTIC SOFTWARE DEVELOPMENT FOR A REAL-TIME SPECTRAL ANALYSIS SYSTEM M.S. Thesis - Rensselaer Polytechnic Inst.
Brian J. Donlan Apr. 1980 175 p refs
(AD-A092441; AFIT-CI-80-9T) Avail: NTIS HC A08/MF A01 CSCL 14/2

This report deals with the development of diagnostic software for a real-time spectral analysis system. The report gives a description of the spectral analysis system and its associated maintainability and reliability problems. The diagnostic system is comprised of a read-only memory board containing a small operating system and diagnostic tests. Detailed descriptions and listings of the tests and operating system are provided. GRA

N81-16762# Colorado Univ. at Boulder.
HARDWARE REALIZATIONS FOR DIGITAL SIGNAL PROCESSING Final Report, 1 Sep. 1978 - 31 Aug. 1980
Richard A. Roberts Oct. 1980 10 p
(Grant DAAG29-78-G-0188)
(AD-A091904; ARO-15974.1-EL) Avail: NTIS HC A02/MF A01 CSCL 09/3

Good digital filter realizations for hardware implementations, in narrowband filtering applications should have low roundoff noise, low coefficient sensitivity, and freedom from overflow oscillations. The hardware implemtations presented here incorporate the above properties into a highly modular structure which can perform computations in pipeline fashion. After an initial delay in output sample, this is obtained for each input sample. The realization and implementations discussed contain more multipliers than direct form realizations. However, by using shorter word lengths because of their increased performance and distributed arithmetic implementations (instead of multiplier structures), these implementations can have less total hardware complexity. GRA

N81-16763# Dartmouth Coll., Hanover, N.H. Dept. of Mathematics.
NATURAL LANGUAGE DATA BASE QUERY Final Report
Larry R. Harris 1 Oct. 1980 24 p
(Contract N00014-75-C-0514; NR Proj. 049-344)
(AD-A092500) Avail: NTIS HC A02/MF A01 CSCL 05/2

This final report is intended to be a summary of the research on Natural Language Data Base Query. It has been the goal of this research to determine a minimal set of techniques sufficient to provide a practical natural language capability for data base query. This report summarizes the basic requirements for such a capability and suggests techniques for meeting these requirements. As such, this report is in effect, a specification of the minimal functionality for a practical natural language data base query capability. GRA

N81-16764# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
SOFTWARE PROJECT FORECASTING
Richard A. DeMillo and Richard J. Lipton Oct. 1980 19 p refs Prepared in cooperation with Princeton Univ., N.J.
(Contract N00014-79-C-0231)
(AD-A091923; GIT-ICS-80/09) Avail: NTIS HC A02/MF A01 CSCL 09/2

We have argued that a major use of software metrics is in the forecasting problem for software projects. By analogy with weather forecasting, we may characterize the current state of knowledge in software forecasting as the gathering of portents. While these may be useful and sometimes decisive in project management, they are prescientific and qualitative. Further, it seems very unlikely that the portents can be developed into a useful theory of forecasting. To develop scientific forecasting tools, a rational way of predicting the future from historical primary

data is required. It is also important that the primary data and the measurements used to obtain it satisfy some basic methodological requirements. For example, the hypotheses developed from the measurements should be meaningful in the sense implied by measurement theory. The statistical approach, seeking to predict future events on the basis of historical patterns, seems to be an attractive short range approach to the forecasting problem. The goal of the exact method is to be able to apply largescale computation to many micropredictions to synthesize a quantitative forecast. GRA

N81-16765# Naval Postgraduate School, Monterey, Calif. Dept. of Computer Science.

DESIGN AND IMPLEMENTATION OF AN INTEGRATED SCREEN-ORIENTED TEXT EDITING AND FORMATTING SYSTEM M.S. Thesis

Lisa Anne Talmage Jun. 1980 155 p refs

(AD-A092180) Avail: NTIS HC A08/MF A01 CSCL 09/2

Text editors and text formatters/processors are described. The state-of-the-art in text processing is examined. Design and implementation considerations in developing an interactive, integrated, screen-oriented text editing and formatting system are discussed. A Berkeley PASCAL implementation of such a system for a PDP-11 minicomputer under the UNIX timesharing system is presented. Intended system users are non-computer scientists, e.g., secretaries, business executives, engineers, students, etc. Programming experience is not required to utilize the system. GRA

N81-16766# Ballistic Research Labs., Aberdeen Proving Ground, Md.

WNDWBX: TEKTRONIX PLOTTING ON CDC

Ronald D. Anderson Sep. 1980 26 p refs

(DA Proj. 1L1-61102-AH-43)

(AD-A092377; AD-E430530; ARBRL-TR-02266) Avail: NTIS HC A03/MF A01 CSCL 09/2

WNDWBX is an interactive plotting program accessible through a single FORTRAN CALL. It uses given input data to generate curves and label axes. Titles, new axis dimensions, and curve labels can be supplied interactively. The user is not required to have plot software knowledge or experience. GRA

N81-16767# Air Force Weapons Lab., Kirtland AFB, N. Mex.

QUANTA: USERS MANUAL Final Report

Maria E. Badessa Jul. 1980 179 p refs

(AF Proj. 8809)

(AD-A092379; AD-E200607; AFWL-TR-79-193) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report provides instructions for using the QUANTA computer code, a code developed within the Applied Physics Division of the Air Force Weapons Laboratory to study the survivability of a flushing aircraft force from a nuclear attack of sea launched ballistic missiles. Included topics are structure of the input deck, description of the restart capabilities, details of array sizes, and a list of the error messages that might be encountered. The most current version of the QUANTA code is attached as Appendix A. GRA

N81-16768# Stanford Univ., Calif. Dept. of Operations Research.

AN ADDITIVE ALGORITHM FOR THE MULTIPLE CHOICE INTEGER PROGRAM

James Carl Bean Oct. 1980 129 p refs

(Contract N00014-76-C-0418; Grant NSF MCS-76-81259; NR Proj. 047-061)

(AD-A092691; TR-96; TR-80-26) Avail: NTIS HC A07/MF A01 CSCL 12/1

The problem dealt with in this report is the Multiple Choice Integer Program (MCIP), a special case of the integer linear programming problem with binary variables. In this problem the variables are partitioned (using the classical definition of 'partition'). Exactly one variable in each partitioning set has the value one in any feasible solution and all other variables have the value zero. The problem also allows any additional constraints that can be expressed as linear inequalities. The objective is to choose elements from these sets so as to minimize cost. Chapter 2 discusses the history of this problem and solution techniques developed for it and similar problems such as the classical assignment problem, the generalized assignment problem, the multiple choice problem, the generalized upper bounding problem and the multiple choice knapsack problem. Chapter 3 presents discussion of additive type algorithms and the algorithm proposed in this report. It also includes definitions and notations. Applications of this algorithm follow in Chapter 4 with worked examples for three problems: a scheduling problem, an assembly line balancing problem and a distribution problem. In Chapter 5 it is proven that the algorithm will correctly solve any problem of this type in finite time. In Chapter 6, Geoffrion's surrogate constraints are revised to take advantage of the additional structure in this problem. Three possible formulations of surrogate constraint LP's are presented. By taking advantage of the special structure of the MCIP, the size of the LP's relative to those used for general binary programming is greatly reduced. GRA

N81-16769# University of Southern California, Marina del Rey. Information Sciences Inst.

A DATABASE FOUNDATION FOR PROCESS SPECIFICATIONS

Neil M. Goldman and David S. Wile Oct. 1980 33 p refs

(Contract DAHC15-72-C-0308; ARPA Order 2223)

(AD-A092567; ISI/RR-80-84) Avail: NTIS HC A03/MF A01 CSCL 09/2

A language suitable for system specification should allow a specification to be based on a cognitive model of the process being described. In part, such a language can be obtained by properly combining certain conceptual abstractions of data models with reference and control concepts designed for programming languages. Augmenting the resulting language with formal versions of several natural language constructs further decreases the cognitive distance between specifications of large systems and the modelled world. Several core elements of such a specification language are developed in this report. Emphasis is placed on modes of expression, such as declarative constraints and temporal reference, which are derived from natural language but are not available in existing formal languages. GRA

N81-16770# Naval Research Lab., Washington, D. C.

ABSTRACT INTERFACE SPECIFICATIONS FOR THE A-7E DEVICE INTERFACE MODULE

Robert A. Parker, Kathryn L. Heininger, David L. Parnas, and John E. Shore 20 Nov. 1980 177 p refs

(ZF21242001)

(AD-A092696; NRL-MR-4385) Avail: NTIS HC A09/MF A01 CSCL 09/2

As part of the experimental redesign of the flight software for the Navy's A-7 aircraft, software modules were designed to encapsulate the characteristics of hardware devices connected to the computer. The purpose of these device interface modules is to allow the remainder of the software to remain unchanged when devices are changed or replaced. To achieve this purpose, the modules were designed according to the abstract interface principle, documented according to a standard organization and reviewed by a systematic procedure based on the properties expected of abstract interfaces. This report contains: (1) an explanation of the abstract interface approach, (2) a description of the standard organization for inteface specifications, (3) a description of the review procedure, and (4) interface specifications for all the device interface modules in the A-7 software. As well as serving as development and maintenance documentation for the A-7 redesign, this document is intended to serve as a model for the other people interested in applying the abstract interface approach on other software projects. GRA

N81-16771# Naval Research Lab., Washington, D. C. Chemistry Div.

CALQ8: A FORTRAN IV CALCULATOR EMULATION PROGRAM Final Report

Daniel F. Birn and John C. Cooper 18 Nov. 1980 39 p refs

(RR0240341)

(AD-A092569; NRL-MR-4377) Avail: NTIS HC A03/MF A01 CSCL 09/2

CALQ8 is a FORTRAN IV program which emulates a multi-functional arithmetic calculator on a mini-computer. Extensive calculation power is provided without requiring any programming skill. This program was designed for and implemented on a Hewlett-Packard model 1000 mini-computer with an

RTE operating system. It contains substantial error checking and supports wide variety of functions not available on hand-held calculators. GRA

N81-16772# Argonne National Lab., Ill. Applied Mathematics Div.
SLIDES: A PROGRAM TO DRAW SLIDES AND POSTERS
Richard M. Bertrand, ed. and Margaret M. Cekis Aug. 1980 43 p refs
(Contract W-31-103-eng-38)
(ANL-77-26(Rev-1)) Avail: NTIS HC A03/MF A01

The slides and posters. When run on an interactive system, the program can display its output on an interactive graphics terminal; in batch, it can direct its graphical output to a variety of plotters. The program uses DISSPLA graphical subroutines and standard subroutines from the AMD plotting utility library, PLOTUTL. This material is written for the novice computer user, who should be able to produce useful slides or posters by following the examples. This also serves as a reference manual for the SLIDES program. E.D.K.

N81-16773# National Technical Information Service, Springfield, Va.
A DIRECTORY OF COMPUTER SOFTWARE APPLICATIONS: ENERGY Progress Report, Feb. 1977 - Apr. 1980
Apr. 1980 305 p
(PB80-105497; NTIS/SA-80/01) Avail: NTIS HC $30.00/MF $30.00 CSCL 09B

Computer programs and/or documentation developed for a variety of applications to the field of energy are cited. The computer software includes applications to solar, geothermal and nuclear energy; petroleum and natural resources; batteries; electrohydrodynamics and magnetohydrodynamic generators; and hydroelectric power production. Examples of software use include simulation and modeling, calculations of future energy requirements, calculatons of conservations measures and computations of economic considerations of energy systems. GRA

62 COMPUTER SYSTEMS

Includes computer networks.

N81-16774# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PASM: A RECONFIGURABLE MULTIMICROCOMPUTER SYSTEM FOR IMAGE PROCESSING Interim Report
Howard Jay Siegel Apr. 1980 8 p Presented at Workshop on New Computer Architectures and Image Processing, Ischia, Italy, 2-5 Jun. 1980
(Grant AF-AFOSR-3581-78; AF Proj. 2304)
(AD-A092182; AFOSR-80-1087TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

As a result of the microprocessor revolution, it is now feasible to build multimicroprocessor systems capable of performing image processing tasks more rapidly than previously possible. There are several types of parallel processing systems. An SIMD (single instruction stream - multiple data stream) machine typically consists of a set of N processors, N memories, an interconnection network and a control unit (e.g., Illiac IV). The control unit broadcasts instructions to the processors and all active ('turned on') processors execute the same instruction at the same time. Each processor executes instructions using data taken from a memory with which only it is associated. The interconnection network allows interprocessor communication. An MSIMD (multiple-SIMD) systems is a parallel processing system which can be structured as two or more independent SIMD machines (e.g., MAP). An MIMD (multiple instruction stream - multiple data stream machine typically consists of N processors and N memories, where each processor can follow an independent instruction stream (e.g., C.mmp). As with SIMD architectures, there is a multiple data stream and an interconnection network. A partitionable SIMD/MIMD system is a parallel processing system which can be structured as two or more independent SIMD and/or MIMD machines. GRA

N81-16775# California Univ., Berkeley. Electronics Research Lab.
NETWORK MANAGEMENT RESEARCH
C. V. Ramamoorthy Sep. 1980 55 p refs
(Contract DAAG29-79-C-0171)
(AD-A092055; ARO-16984.1-A-EL) Avail: NTIS HC A04/MF A01 CSCL 09/2

In our research in distributed data processing systems, we have developed design principles, algorithm concepts, feasibility criteria, and quantitative trade-offs that can be used in the creation of network management functions. In particular, we concentrated on the following five areas: (1) routing control and relay management; (2) reconfiguration control; (3) interconnection network design; (4) deadlock detection; and (5) scheduling. The results we have developed will provide guidelines and design laws for the systematic design and construction of distributed data processing systems such that the users' requirements are satisfied. By using these results, we will be able to develop reliable, effective, modifiable networks with low cost and lead times. GRA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N81-16776# Maryland Univ., College Park. Computer Vision Lab.
SURFACES IN THREE-DIMENSIONAL DIGITAL IMAGES Interim Report
David G. Morgenthaler and Azriel Rosenfeld Sep. 1980 25 p refs
(Grant AF-AFOSR-3271-77; AF Proj. 2304)
(AD-A092075; TR-940; AFOSR-80-1154TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

This is one of a series of reports on the digital geometry of three dimensional images, such as those produced by computed tomography. In this report we define simple surface points and simple closed surfaces, and show that any connected collection of simple surface points form a simple closed surface, thus proving a three dimensional analog of the two dimensional Jordan curve theorem. We also show that the converse is not a theorem (in contrast to the two dimensional case) and discuss more complex surfaces types. GRA

N81-16777# Goodyear Aerospace Corp., Akron, Ohio.
STARAN IMAGE PROCESSING Final Technical Report, Sep. 1979 - Oct. 1980
R. W. Lott, S. G. Stadelman, and R. O. Faiss Oct. 1980 91 p refs
(Contract DAAK70-79-C-0221)
(AD-A091928; GER-16902; ETL-0243) Avail: NTIS HC A05/MF A01 CSCL 09/2

The primary objective of this work was the implementation of a label relaxation edge enhancement algorithm for use on the STARAN computer. The algorithms were designed to allow for various user defined control parameters so as to be able to evaluate the method of edge enhancement under different conditions. During software execution, STARAN handles the bulk of the computational tasks while the CDC 6400 serves as the I/O and process controller. The CDC 6400 control and I/O software is given access to the STARAN software via calls to CDC resident FORTRAN subroutines. As a result, the general CDC 6400 FORTRAN programmer can incorporate the functional capabilities of the developed STARAN subroutine into his own program. The algorithm develops likelihood (probability estimates) values of directed edges in an image for 8 compass directions. 3x3 correlation reference patterns are used to develop the initial likelihood values. The likelihood values are then iteratively enhanced by a relaxation process. The likelihood enhancement process involves two basic steps: (1) the best link of likelihood ratio estimates between adjacent neighbor pixel pairs is established. In the second step, the best link pair information is used to update the edge likelihood ratio. The CDC/STARAN

system can process one iteration in under one minute, thus providing an interactive evaluation capability. GRA

N81-16778# SRI International Corp., Menlo Park, Calif.
VIDEO STREAM PROCESSORS: A COST-EFFECTIVE COMPUTATIONAL ARCHITECTURE FOR IMAGE PROCESSING Final Report, 22 Sep. 1978 - 21 Nov. 1979
Jay M. Tenenbaum Jun. 1980 72 p refs
(Contract DAAK70-78-C-0114)
(AD-A092146; ETL-0229) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report evaluates the capabilities of a new class of image-processing systems, known generically as video stream processors (VSPs). VSPs are an outgrowth of image display technology; image data from the display memory are streamed at video rates through a digital-processing unit and back to memory for subsequent display or further processing. This architecture serially simulates a parallel-array processor and is capable, in principle, of executing any locally parallel operation, such as convolution and edge detection, at a fraction of the cost of a truly parallel system. Our evaluation begins with a general discussion of the architecture and use of VSPs that highlights the fundamental concepts and vast application potential of this class of machines. This discussion is based on a hypothetical VSP design in order to avoid artificial constraints imposed by design limitations of any particular commercial product. The hypothetical design also serves as a standard against which current implementations can be evaluated. The report next summarizes our experience with the IP-5000 Image Array Processor, currently the most advanced commercially available VSP. The IP-5000 design is critiqued in the context of the hypothetical design, followed by a presentation of experimental results at SRI. The concluding discussion analyzes the IP-5000's limitations and proposes design refinements that would significantly improve its utility. GRA

N81-16779# White Sands Missile Range, N.Mex. Instrumentation Directorate.
AUTOMATED READING OF VIDEOTAPE Final Report
Raul G. Machuca Nov. 1980 75 p refs
(DA Proj. 1L1-61101-A-91A)
(AD-A092224; STEWS-ID-80-2) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes the concepts and software which are used in a prototype videotape reader being developed at WSMR. The goal is to read from one frame of video the position of the target and the three angular rotations of the target. This is done by first making a contour of the target from a frame of video. The Fourier descriptors of the contour are then computed and normalized. GRA

N81-16780# Michigan Univ., Ann Arbor. Computer, Information and Control Engineering Program.
[MARKOV QUEUEING NETWORKS] Final Technical Report, 15 Sep. 1975 - 14 Jul. 1980
Frederick J. Beutler Oct. 1980 7 p refs
(Grant AF-AFOSR-2903-76; AF Proj. 2304)
(AD-A091989; AFOSR-80-1152TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

Since its inception, the subject Grant has been largely concerned with investigations on Markov queueing networks; even though the Markov property provides a powerful analytical tool, many of the fundamental parameters e.g., customer streams, waiting times, transient behavior, sojourn times, were poorly understood. Jackson networks, which perhaps constitute the simplest kind of queueing system, were considered first. Results on conditions for line length equilibrium and related service times and number of service per customer were soon obtained. It was noted that the line length vector describing the Markov system could be augmented to incorporate generalized forms of traffic counts. This led to studies on and identification of Poisson traffic flows on broad classes of queueing networks. GRA

N81-16781# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering.
OPTIMAL CONTROL OF SYSTEMS WITH UNCERTAINTY Final Technical Report, 1 Sep. 1975 - 31 Aug. 1980
W. E. Schmitendorf 31 Aug. 1980 15 p refs
(Grant AF-AFOSR-2423-79; AF Proj. 2304)
(AD-A092389; AFOSR-TR-1183TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The research supported by AFOSR Grant 76-2923 has led to significant results which can be used in the design of optimal controllers when disturbances are present. Sufficient conditions which a minmax control must satisfy were developed for systems with disturbances in the state equation or in the measurement of the initial state. From these conditions, constructive techniques were developed which can be used to generate minmax controllers. The second major area of the research was controllability problems. Criteria for determining the controllability properties of constrained systems were derived. The criteria involve finite dimensional optimization problems and are amenable to computer implementation. GRA

N81-16782# Stanford Univ., Calif. Dept. of Operations Research.
AN APPROACH TO REGENERATIVE SIMULATION ON A GENERAL STATE SPACE
Peter W. Glynn Jul. 1980 79 p refs
(Contract N00014-76-C-0578; Grant NSF MCS-79-09139)
(AD-A092221; SU-TR-53) Avail: NTIS HC A05/MF A01 CSCL 12/1

A wide variety of stochastic systems may be viewed as Markov chains taking on values in a general state space. An example is the class of generalized semi-Markov processes, which are commonly obtained in network queueing problems via the technique of supplementary variables. A simulator is often interested in obtaining steady state properties of such a system. Some recent developments in Markov chain theory by Athreya, Ney, and Nummelin allow one to embed a certain subclass of these processes in a regenerative environment. We study some consequences of this embedding and develop statistical estimation procedures for the general problem that bear close resemblance to the regenerative method of simulation analysis for finite state Markov chains. GRA

N81-16783# Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.
APPROXIMATION TECHNIQUES FOR PARAMETER ESTIMATION IN HEREDITARY CONTROL SYSTEMS Interim Report
H. T. Banks and I. G. Rosen Sep. 1980 15 p refs
(Contract DAAG29-79-C-0161; Grants AF-AFOSR-3092-76; NSF MCS-79-05774; AF Proj. 2304)
(AD-A092184; AFOSR-80-1116TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

Two types of approximation techniques for parameter estimation of delay systems are described and compared. One involves state discretization only the other entails simultaneous state and time discretization. GRA

N81-16784# Houston Univ., Tex. Dept. of Electrical Engineering.
APPROXIMATE LINEAR REGULATOR AND KALMAN FILTER Final Report, 1 Jun. 1977 - 31 Aug. 1980
Leang S. Shieh and Willon B. Wai 1 Sep. 1980 150 p refs
(Contract DAAG29-79-C-0178; Grant DAAG29-77-G-0143)
(AD-A092176; ARO-14483.12M) Avail: NTIS HC A07/MF A01 CSCL 12/1

Practical dynamic systems constantly face unpredictable fluctuations and disturbances for which Kalman filter has been shown to be effective in estimating the states from the outputs corrupted by white noises. This is the Kalman filtering problem. On the other hand, the Linear regulator problem, which is the mathematical dual of the Kalman filtering problem, plays an important role in modern optimal control theory. Both problems can be formulated as quadratic synthesis problems. A geometric-series approach is used to approximate the exponentials of Hamiltonian matrices for the quadratic synthesis problems. The approximants of the discretized transition matrices are then used to construct piecewise-constant gains and piecewise time-varying gains for approximating time-varying optimal gains and time-varying Kalman gains. Simple and fast algorithms are developed and can be easily implemented on a low cost minicomputer or microprocessor. The proposed methods have been successfully applied to the analysis of practical control systems. GRA

N81-16785# Maryland Univ. -College Park. Computer Vision Lab.
PIXEL CLASSIFICATION BASED ON GRAY LEVEL AND LOCAL BUSYNESS
Philip A. Dondes and Azriel Rosenfeld Mar. 1980 31 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A091996; TR-874) Avail: NTIS HC A03/MF A01 CSCL 09/2

An image can be segmented by classifying its pixels using local properties as features. Two intuitively useful properties are the gray level of the pixel and the busyness, or gray level fluctuation, measured in its neighborhood. Busyness values tend to be highly variable in busy regions; but great improvements in classification accuracy can be obtained by smoothing these values prior to classifying. An alternative possibility is to classify probabilistically and use relaxation to adjust the probabilities. GRA

N81-16786# Maryland Univ. -College Park. Computer Vision Lab.
IMAGE APPROXIMATION FROM GRAYSCALE MEDIAL AXES
Shyuan Wang, Y. Angela, and Azriel Rosenfeld May 1980 33 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A091993; TR-900) Avail: NTIS HC A03/MF A01 CSCL 09/2

Several types of gray-weighted 'medial axes' have been defined. This paper shows that one of them, the min-max medial axis, can be used to reconstruct good approximations to the original image based on a relatively small amount of information. GRA

N81-16787# Maryland Univ. -College Park. Computer Science Center.
ARCHITECTURE FOR HIGHER LEVEL DIGITAL IMAGE PROCESSING Quarterly Status Report
Arden Helland and Josh Hung 29 Feb. 1980 143 p refs
Prepared in cooperation with Westinghouse Defense and Electronic Systems Center, Baltimore
(Contract DAAG53-76-C-0138)
(AD-A091994; QSR-7) Avail: NTIS HC A07/MF A01 CSCL 09/2

This report demonstrates results of the one dimensional, three label relaxation process. The process is easily reduced to two labels; this is used to demonstrate the properties of relaxation as analyzed in the sixth quarterly report. The results are shown to confirm the analysis regarding speed of convergence, threshold and stability. Relaxation converged to stable results only when the net alike coefficients are equal; best results are obtained with the fewest iterations when the unlike coefficients are zero. The three label process provided correct segmentation results even when the input image contained less than three distinct subpopulations. GRA

N81-16788# Stanford Univ., Calif. Dept. of Computer Science.
KNOWLEDGE ENGINEERING: THE APPLIED SIDE OF ARTIFICIAL INTELLIGENCE
Edward A. Feigenbaum Sep. 1980 1 p refs
(Contract N00014-80-C-0609)
(AD-A092574; SU-STAN-CS-80-812; HPP-80-121) Copyright. Avail: Issuing Activity CSCL 09/2

Expert System research in an emerging area of computer science that exploits the capabilities of computers for symbolic manipulation and inference to solve complex and difficult reasoning problems at the level of performance of human experts. The methods of this area are designed to acquire and represent both the formal and the informal knowledge that experts hold about the tasks of their discipline. Numerous applications to science, engineering, and medicine have been accomplished. Expert System projects represent applied artificial intelligence research, though they also make salient numerous fundamental research issues in the acquisition, representation and utilization of knowledge by computer programs. Knowledge engineering approaches promise significant cost savings in certain applications; intelligent computer-based aids for practitioners in fields whose knowledge is primarily nonmathematical; and the elucidation of the heuristic knowledge of experts, the largely private knowledge of practice. There are major problems of knowledge engineering including the shortage of adequate computer equipment, the shortage of trained specialists in applied artificial intelligence, the scientific base for adequate knowledge acquisition, and the lack of sustained funding. GRA

N81-16789# Maryland Univ., College Park. Dept. of Computer Science.
COMPUTER AIDED PROGRAM SYNTHESIS
Richard J. Wood Jan. 1980 38 p refs
(Contract N00014-76-C-0477)
(AD-A092621; TR-861) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper proposes the construction of a programming system that will interact with a domain expert user to develop a computer program. Activities evident during a client-consultant interaction are identified and examined, and a new program structure called the Program Model (PM) is presented. The PM explicitly represents the definitions and refinements of the problem domain, the development of an algorithmic solution, and the programming knowledge used during synthesis. The types of processing required for a computer aided synthesis system are examined and a control scheme is proposed for managing non-linear program development. GRA

N81-16790# E-Systems, Inc., Dallas, Tex. Garland Div.
STUDY OF DIGITAL MATCHING OF DISSIMILAR IMAGES Final Report
Don S. Rhines 31 Oct. 1980 93 p
(Contract DAAK70-79-C-0235)
(AD-A092813; ETL-0244) Avail: NTIS HC A05/MF A01 CSCL 09/2

This final report presents the results of a study conducted for the U. S. Army Engineering Topographic Laboratories on the digital matching of dissimilar images. This report develops a practical approach for the digital determination of corresponding points on dissimilar images. This approach could be used to register a large number of points automatically in a resonable short period of time. The algorithms required are presented in a manner that can be coded in fortran IV and tested on the DIAL facility at USAETL. GRA

N81-16791# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
A QUEUEING NETWORK APPROACH TO A CREW SCHEDULING PROBLEM Final Report, Oct. 1979 - Jan. 1980
Arnold L. Sweet Sep. 1980 22 p refs
(AF Proj. 7930)
(AD-A092834; SAM-TR-80-35) Avail: NTIS HC A02/MF A01 CSCL 12/2

The following optimization problem is considered; airplanes fly on prescribed routes and are flown by crews who must be rested after the passage of a certain interval of flying time. Rested crews who are stationed at bases on the routes can be deployed to keep the planes in flight. For a prescribed number of planes and crews, it is desired to place the crews at bases such that the amount of time spent by the planes in the air is a maximum. This paper investigates the use of a queueing network model as a means of formulating the optimization problem. Upper and lower bounds are presented for the expected fraction of time planes are airborne. These bounds may be useful in solving the optimization problem by means of a simulation model. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N81-16792# North Carolina Univ. at Chapel Hill. Inst. of Statistics.
WEAK CONVERGENCE OF BOUNDED INFLUENCE REGRESSION ESTIMATES WITH APPLICATIONS Interim Report
Raymond J. Carrol and David Ruppert Apr. 1980 24 p refs

(Grants AF-AFOSR-0080-80; NSF MCS-78-0124; AF Proj. 6110)
(AD-A092792; MIMEO-SER-1285) Avail: NTIS HC A02/MF A01 CSCL 12/1

We obtain weak convergence results for bounded influence regression M-estimates and apply the results to sequential clinical trials, with special reference to repeated significance tests in the two-sample problem with covariates. GRA

N81-16793# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A COMPOSITE ALGORITHM FOR MIXED INTEGER CONTRAINED NONLINEAR OPTIMIZATION Ph.D. Thesis - Illinois Univ.

Daniel B. Fox Jan. 1980 234 p refs
(AD-A092435; AFIT-CI-80-1D) Avail: NTIS HC A11/MF A01 CSCL 21/1

A composite optimization algorithm applicable to mixed integer, constrained, nonlinear problems is developed in this research. One major component of the composite algorithm is a modified version of the nonlinear simplex method. Significant modifications are made to this algorithm including the incorporation of a unidimensional search procedure and the use of a new method to treat constraints. Additional features of the composite algorithm include new acceleration strategies, a new decomposition approach, and a discrete grid algorithm. The components of the composite algorithm are tested on problems primarily selected to represent engineering design optimization applications. The performance of the new methods is compared to some existing techniques. Examples of the application of combinations of the composite components are included. The results indicate that the new algorithms obtain superior solutions and in most cases are more efficient than existing techniques. GRA

N81-16794# Lee (J. S.) Associates, Inc., Arlington, Va.

MULTI-SENSOR DETECTION STUDY Final Report, Apr. - Sep. 1980

Leonard E. Miller 30 Sep. 1980 112 p refs
(Contract N60921-80-C-0107)
(AD-A091954; JTR-80-02) Avail: NTIS HC A06/MF A01 CSCL 12/1

The methods of complex Gaussian multivariate analysis are applied to the problem of detecting signals in noise using data from multiple sensors whose relative locations are arbitrary. Theory is used to predict detection performance in terms of minimum detectable signal (MDS). A computer program implementing the multivariate detection approach is described, demonstrating that computational requirements are modest and verifying theory by simulation. Significant improvements over single-sensor processing (reduction in MDS by a factor equal to the number of sensors) is shown for certain cases. GRA

N81-16795# Orincon Corp., La Jolla, Calif.

PRACTICAL CONTROL ALGORITHMS FOR NONLINEAR STOCHASTIC SYSTEMS AND INVESTIGATIONS OF NONLINEAR FILTERS Final Technical Report, 1 Feb. 1976 - 31 Jan. 1980

Daniel L. Alspach, Vivek S. Samant, and Harold W. Sorenson Jul. 1980 137 p refs
(Contract F44620-75-C-0023; AF Proj. 2304)
(AD-A092199; OC-R-80-0002AB-1; AFOSR-80-1157TR) Avail: NTIS HC A07/MF A01 CSCL 12/1

This report summarizes research in problems of stabilization and control of nonlinear stochastic systems observed by noisy measurement data, and the difficulties encountered in processing this noise-contaminated measurement data to obtain accurate estimates of the states of the system. Such problems are inherent in many Air Force systems applications. If it is possible to estimate the state of the system accurately, then well-known classical deterministic control techniques may often be used to give adequate system performance. This approach will greatly reduce the complexity of the control algorithms over that required by the optimal policy. On the other hand the use of nonlinear filtering techniques in place of the simpler linearized filters can greatly increase the accuracy of the state estimates and thereby improve system performance and alleviate divergence problems. GRA

N81-16796# Rochester Univ., N. Y. Dept. of Electrical Engineering.

SOME MATHEMATICAL CONSIDERATIONS IN DEALING WITH THE INVERSE PROBLEMS

Tapan K. Sarkar, Donald D. Weiner, and Vijay K. Jain Apr. 1980 20 p refs Prepared in cooperation with Syracuse Univ., N.Y. and Univ. of South Florida, Tampa
(Contract N00014-79-C-0598; RR0210101)
(AD-A092261; TR-80-3; TR-2) Avail: NTIS HC A03/MF A01 CSCL 12/1

Many problems of mathematical physics can be formulated in terms of the operator equation $Ax = y$, where A is an integro-differential operator. Given A and x, the solution for y is usually straightforward. However, the inverse problem which consists of the solution for x when given A and y, is much more difficult. In this paper, the following questions relative to the inverse problem are explored: (1) Does specification of the operator A determine the set (y) for which a solution x is possible? (2) Does the inverse problem always have a unique solution? (3) Do small perturbations of the forcing function y always result in small perturbations of the solution? (4) What are some of the considerations that enter into the choice of a solution technique for a specific problem? The concept of an ill-posed problem versus that of a well-posed problem is discussed. Specifically, the manner by which an ill-posed problem may be regularized to a well-posed problem is presented. The concepts are illustrated by several examples. GRA

N81-16797# Wisconsin Univ. - Madison. Mathematics Research Center.

A POPULATION OF LINEAR, SECOND ORDER, ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS ON RECTANGULAR DOMAINS, PART 1 Technical Summary Report

John R. Rice, Elias N. Houstis, and Wayne R. Dyksen May 1980 48 p refs
(Contracts DAAG29-75-C-0024; DAAG29-80-C-0041; Grants NSF MCS-77-01408; NSF MCS-79-01437)
(AD-A092248; MRC-TSR-2078-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

We present a population of 56 linear, two dimensional elliptic partial differential equations (PDEs) suitable for evaluating numerical methods and software. Forty-two of the PDEs are parameterized which allows much larger populations to be made; 189 specific cases are presented here along with solutions (some are only approximate). Many of the PDEs are artificially created so as to exhibit various mathematical behaviors of interest; the others are taken from real world problems in various ways. The population has been structured by introducing measures of complexity of the operator, boundary conditions, solution, and problem. The PDEs are first presented in mathematical terms along with contour plots of the 189 specific solutions. Machine readable descriptions are given in Part 2, MRC Technical Summary Report no. 2079; many of the PDEs involve lengthy expressions and about a dozen involve extensive tabulations of approximate solutions. GRA

N81-16798# Stanford Univ., Calif. Dept. of Statistics.

REPEATED LIKELIHOOD RATIO TESTS FOR CURVED EXPONENTIAL FAMILIES

Steven Paul Lalley 1 Sep. 1980 68 p refs
(Contract N00014-77-C-0306; NR Proj. 042-373)
(AD-A092634; TR-10) Avail: NTIS HC A04/MF A01 CSCL 12/1

A class of repeated significance tests for curved hypotheses in multiparameter exponential familes is studied, and asymptotic formulae for the significance levels of such tests are obtained. Special attention is given the important case of comparing Bernoulli success probabilities. GRA

N81-16799# Stanford Univ., Calif. Dept. of Statistics.

MULTIDIMENSIONAL INFINITELY DIVISIBLE VARIABLES AND PROCESSES. PART 1: STABLE CASE

Raoul LePage 23 Oct. 1980 26 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A092609; TR-292) Avail: NTIS HC A03/MF A01 CSCL 12/1

Elementary series constructions, involving a Poisson process, are obtained for multidimensional stable variables and random

functions. Symmetric stable laws are shown to be mixtures of Gaussain laws. GRA

N81-16800# Stanford Univ., Calif. Dept. of Statistics.
METHODS AND APPLICATIONS OF TIME SERIES ANALYSIS. PART 1: REGRESSION, TRENDS, SMOOTHING AND DIFFERENCING
Theodore W. Anderson and N. D. Singpurwalla (George Washington Univ.) Jul. 1980 107 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A092575; TR-42-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 12/1

This is the first in a series of technical reports developing the most modern procedures of time series analysis and forecasting for use in engineering, the physical sciences and the social sciences. The exposition of methodology is based on a succinct presentation of the theoretical background and is illustrated with appropriate examples from engineering, maintenance and reliability, economics and other physical and social sciences. The first is concerned with regression, trends, smoothing and differencing. GRA

N81-168^1# Washington Univ., Seattle. Dept. of Computer Science.
BOOLEAN VARIABLES IN REGULAR EXPRESSIONS AND FINITE AUTOMATA
Karl R. Abrahamson Aug. 1980 26 p refs
(Contract N00014-80-C-0221; Grant NSF MCS-77-02474; NR Proj. 049-456)
(AD-A092666; TR-80-08-02) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers questions of succinctness of representation of regular sets by regular expressions and finite automata which may contain special instructions for setting and testing auxiliary Boolean variables. GRA

N81-16802# Massachusetts Univ., Amherst. Dept. of Mathematics and Statistics.
A CHARACTERIZATION OF A POLYA-EGGENBERGER AND OTHER DISCRETE DISTRIBUTIONS BY RECORD VALUES
Ramesh M. Korwar Sep. 1980 9 p refs
(Grant AF-AFOSR-0219-80; AF Proj. 2304)
(AD-A092536; TR-8; AFOSR-80-1180TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Let X sub 1, X sub 2, ..., be a sequence of independent and identically distributed discrete random variables. Define the sequence N(n) by N(1)=1, N(n)=min such that j/j N(n-1), X sub j X sub n (n-1), n=2,3,... Let R sub n=X sub N(n). Then R sub n is the sequence of record values. By convention R sub 1=X sub 1. Here a characterization of a Polya-Eggenberger and other discrete distributions including the geometric, is made by the linearity of regression of R sub 2 -R sub 1 on R sub 1. GRA

N81-16803# Naval Underwater Systems Center, New London, Conn. Information Services Dept.
TWO EXPONENTIAL APPROXIMATION METHODS
Roy L. Streit 28 Oct. 1980 23 p refs
(NUSC Proj. A70210)
(AD-A092728; NUSC-TR-6357) Avail: NTIS HC A02/MF A01 CSCL 12/1

Two different constructive techniques for approximating positive definite functions by means of finite exponential sums are explored. One technique constructs the coefficients and the exponents. The other technique constructs the exponents when the coefficients are all required to be equal. Both approximation techniques appear to be suitable for numerical computation. The techniques extend to completely monotonic functions as well. Error bounds are proved using elementary methods. In an application, these error bounds can be used to eliminate some of the effort and guesswork previously necessary in two procedures for the design and synthesis of sparse broadband linear arrays. GRA

N81-16804# Oak Ridge National Lab., Tenn. Radiation Shielding Information Center.
STATUS OF MULTIGROUP SENSITIVITY PROFILES AND COVARIANCE MATRICES AVAILABLE FROM THE RADIATION SHIELDING INFORMATION CENTER
R. W. Roussin, J. D. Drischler, and J. H. Marable 1980 6 p refs
(Contracts W-7405-eng-26; NRC-41-88-54-80-3; NRC-41-88-54-80-8)
(CONF-8010113-1) Avail: NTIS HC A02/MF A01

The addition of multigroup sensitivity profiles and covariance matrices to the Radiation Shielding Information Center's data library collection is reported. Sensitivity profiles are available in a single package, DLC-45/SENPRO and covariance matrices are found in two packages, DLC-44/COVERX and DLC-77/CONVERV. The contents of these packages are described and their availability is discussed. M.G.

N81-16805# Argonne National Lab., Ill. Applid Mathematics Div.
LCLSQ: AN IMPLEMENTATION OF AN ALGORITHM FOR LINEARLY CONSTRAINED LINEAR LEAST-SQUARES PROBLEMS
Roger L. Crane (RCA, Princeton, N.J.), Burton S. Garbow, Kenneth E. Hillstrom, and Michael Minkoff Nov. 1980 45 p refs
(ANL-80-116) Avail: NTIS HC A03/MF A01

The implementation of an algorithm of Stoer and Schittkowski for solving linearly constrained linear least squares problems is described. These problems arise in many areas, particularly in data fitting where a model is provided and parameters in the model are selected to be a best least squares fit to known experimental observations. By adding constraints to the least squares fit, one can force user specified properties on the parameters selected. The algorithm used applies a numerically stable implementation of the Gram-Schmidt orthogonalization procedure to deal with a factorization approach for solving the constrained least squares problem. The software developed allows for either a user-supplied feasible starting point or the automatic generation of a feasible starting point, redecomposition after solving the problem to improve numerical accuracy, and diagnostic printout to follow the computations in the algorithm. In addition to a description of the actual method used to solve the problem, a description of the software structure and the user interfaces is provided, along with a numerical example. Author

N81-16806# Sandia Labs., Albuquerque, N. Mex.
ALGEBRA: A COMPUTER PROGRAM THAT ALGEBRAICALLY MANIPULATES FINITE ELEMENT OUTPUT DATA
Mary A. Richgels and Johnny H. Biffle Sep. 1980 24 p refs
(Contract AT(29-1)-789)
(SAND-80-2061) Avail: NTIS HC A02/MF A01

ALGEBRA is a program that allows the user to process output data from finite element anlaysis codes before they are sent to plotting routines. These data take the form of variable values (stress, strain, and velocity components, etc.) on a tape that is both the output tape from the analyses code and the input tape to ALGEBRA. The ALGEBRA code evaluates functions of these data and writes the function values on an output tape that can be used as input to plotting routines. Convenient input format and error detection capabilities aid the user in providing ALGEBRA with the functions to be evaluated. Author

N81-16807# Oak Ridge National Lab., Tenn. Computer Sciences Div.
THE ADVANTAGES OF INVERTED OPERATORS IN RAYLEIGH-RITZ APPROXIMATIONS
D. S. Scott Nov. 1980 21 p refs Sponsored in part by Linkoping Univ., and the Office of Energy Research
(Contract W-7405-eng-26)
(ORNL/CSD-68) Avail: NTIS HC A02/MF A01

Generalized eigenvalue problems are often solved by a combination of inverse iteration and the Rayleigh-Ritz procedure. It was shown that significant advantages can be obtained in this context by applying the Rayleigh-Ritz procedure to an inverted operator. T.M.

N81-16808# Rice Univ., Houston, Tex. Dept. of Engineering.
FREQUENCY DOMAIN DESIGN OF MULTIVARIABLE CONTROL SYSTEMS Final Report, 1 Jun. 1977 - 30 Nov. 1979
J. Boyd Pearson Feb. 1980 11 p refs

(Grant NSF ENG-77-04119)
(PB81-103541; NSF/RA-800143) Avail: NTIS HC A02/MF A01 CSCL 12A

Frequency, domain formulations were used to establish new theoretical results in multivariable control system synthesis and to obtain computational algorithms to aid in the implementation of the theory for control system design. A general formulation and solution was obtained to the linear multivariable regulator problem, and two new algorithms were developed for computing with polynomial matrices. These algorithms, one for computing unimodular matrices and their inverses are of interest in linear system theory and are not restricted only to control system applications. GRA

N81-16809# National Technical Information Service, Springfield, Va.
INTEGRATION OF PARTIAL DIFFERENTIAL EQUATIONS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1970 - Sep. 1980
George W. Reymherr Oct. 1980 225 p Supersedes NTIS/PS-79/1066 and NTIS/PS-78/0981
(PB80-815988; NTIS/PS-79/1066; NTIS/PS-78/0981) Avail: NTIS HC $30.00/MF $30.00 CSCL 12A

Research reports on the numerical integration of partial differential equations (PDE) are cited. Some other numerical techniques are presented, including variational methods, finite difference theory, and asymptotic solutions. Research on computer computations of PDE is included. GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N81-16810 State Univ. of New York at Stony Brook.
NON-STATIONARY CONTINGENCY TABLE MARKOV CHAINS Ph.D. Thesis
Joel Alan Waksman 1980 115 p
Avail: Univ. Microfilms Order No. 8100513

Markov chain models of data are analyzed by statistical methods, particularly log linear models. One testable hypothesis is that of stationary which indicates that the transition probability of moving from one state to another is independent of when the transition occurs. Models which structure nonstationary and the testing of the fit of these models to data are discussed. With stationary transition probabilities, the odds are constant at all times and the transition ratios are all one; equivalently all log transition ratios are zero. Therefore, a nonzero log transition ratio reflects nonstationarity. The models considered are interrelated. The nature of these relations is discussed. Two sets of data, taken from a sex therapy center, are used to illustrate the various models. Methods of fitting the models are discussed along with parameter estimation. Included is a computer program which performs the relevant calculations. Dissert. Abstr.

N81-16811 Princeton Univ., N. J.
OPTIMAL DESIGN OF OBSERVATION TIMES FOR CONTINUOUS TIME SERIES Ph.D. Thesis
Allan Reeve Wilks 1980 68 p
Avail: Univ. Microfilms Order No. 8101560

The problem of optimally selecting the observation times for a continuous time series when these times are not assumed equally spaced is discussed. A parametric family of spectra or equivalently, covariance functions, is assumed as the underlying model and the largeness of the Fisher information in the parameters is considered as the criterion to be optimized insofar as it depends on the sampling times. The first of these models is the Gauss-Markov process, the unique, stationary, Gaussian Markov process. Under the second model, the process is an unknown convex combination of two known processes. Only collapsed designs, those for which all the sampling intervals are infinitesimally small, are considered, and conditions on the two known covariance functions of the underlying processes are given, such that the collapsed design is optimal. Dissert. Abstr.

N81-16812 Washington Univ., Seattle.
MEASURING DETERRENCE: IMPERFECT DATA AND ESTIMATION BIAS Ph.D. Thesis
Susan Bradley Long 1980 260 p
Avail: Univ. Microfilms Order No. 8029774

The implications of the use of imperfect data in deterrence research is discussed. Parameter estimates for deterrent effects are shown to be sensitive to moderate levels of random or constant error in measuring offense or sanction rates. Because of error bias, the magnitude, statistical significance, and stability of parameter estimates provide inadequate guidance on substantive significance, the consistency of deterrence findings across studies, the standard scientific criteria of replicability, is shown to be generally enhanced by the presence of such errors in measurement. The investigation of error bias uses a variety of approaches, including computer simulations, reanalysis of prior deterrence studies on index crimes, and results with new sources of data. The failure of current deterrence models to control for differences in seriousness of offenses across jurisdictions (or time periods) is also shown to lead to specification bias.
Dissert. Abstr.

N81-16813# Florida State Univ., Tallahassee. Dept. of Statistics.
OPTIMAL SAMPLE DEPENDS ON OPTIMALITY CRITERION Interim Report
Herbert Lacayo, Carlos A. B. Pereira, Frank Proschan, and Carl Sarndal Oct. 1980 7 p refs
(Grant AF-AFOSR-3678-78; AF Proj. 2304)
(AD-A092658; FSU-STATISTICS-M-559; AFOSR-80-1205TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Four different sampling procedures are compared. Each is optimal under an appropriate optimality criterion. GRA

N81-16814*# National Aeronautics and Space Administration, Washington, D. C.
DESCRIPTION OF STATISTICAL METHODS AND A ROUTINE FOR DETERMINING THE PARAMETERS OF A MODEL IN PROCESSING EXPERIMENTAL RESULTS
D. A. Usikov Jun. 1980 42 p refs Transl. into ENGLISH of "Opisaniye Statisticheskikn Metodov i Programmy diya Opredeleniya Parametrov Modeli pri Obrabotke Rezultatov Eksperimentov" Rept. Pr-383 (USSR), Moscow, 1977 p 42 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. of Space Research, Academy of Sciences (USSR), Moscow
(Contract NASw-3199)
(NASA-TM-76217; Pr-383) Avail: NTIS HC A03/MF A01 CSCL 12A

A computer routine is suggested for selecting the optimum parameters of a theoretical model and determining the errors in them due to errors in physical measurements and for evaluating the conformity of theory with the experiment. The paper describes the specification sequence for the input data and the format of the calculation results. Sample printouts are appended. Author

N81-16815# Wisconsin Univ. - Madison. Mathematics Research Center.
A SEQUENTIAL K-GROUP RANDOM ALLOCATION METHOD WITH APPLICATIONS TO SIMULATION
Andrew P. Soms 11 Nov. 1980 8 p refs
(Contracts DAAG29-80-C-0041; N00014-79-C-0321)
(AD-A092793; MRC-TR-624) Avail: NTIS HC A02/MF A01 CSCL 12/1

A sequential method of random allocation is given and it is shown how it can be used to estimate the observed significance levels of k-sample nonparametric tests. The sequential technique is compared to the standard random allocation technique and shown to be more efficient. An application is made to the Dunn-Bonferroni method of multiple comparisons. GRA

N81-16816# Kentucky Univ., Lexington.
STATE SPACE MODELS FOR GAUSSIAN STOCHASTIC PROCESSES Interim Report
Anders Lindquist and Giorgio Picci 5 Jul. 1980 38 p refs Presented at NATO-ASI Workshop, Les Arcs, France, 22 Jun. - 5 Jul. 1980
(Grants AF-AFOSR-3519-78; NSF ECS-79-03731; AF Proj. 2304)

(AD-A092388; AFOSR-80-1182TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A comprehensive theory of stochastic realization for multivariate stationary Gaussian processes is presented. It is coordinate-free in nature, starting out with an abstract state space theory in Hilbert space, based on the concept of splitting subspace. These results are then carried over to the spectral domain and described in terms of Hardy functons. Each state space is uniquely characterized by its structural function, an inner function which contains all the systems theoretical characteristics of the corresponding realizations. Finally coordinates are introduced and concrete differential-equation-type representations are obtained. This paper is an abridged version of a forthcoming paper, which in turn summarizes and considerably extends results which have previously been presented in a series of preliminary conference papers. GRA

N81-16817# North Carolina Univ., Chapel Hill. Inst. of Statistics.

EXTREMAL AND RELATED PROPERTIES OF STATIONARY PROCESSES. PART 2: EXTREME VALUES IN CONTINUOUS TIME

M. R. Leadbetter, G. Lindren (Umea Univ., Sweden), and H. Rootzen (Copenhagen Univ., Denmark) Oct. 1980 151 p refs Sponsored in part by Swedish Natural Research Council (Contract N00014-75-C-0809)

(AD-A092163; MIMEO-SER-1307) Avail: NTIS HC A08/MF A01 CSCL 12/1

In this work, we explore extremal and related theory for continuous parameter stationary processes. A general theory extending that for the sequence case, described in Chapter 2 of Part 1, is obtained, based on dependence conditions closely related to those used there for sequences. In particular, a general form of Gnedenko's Theorem is proved for the maximum M(T) = sup (Xi(t); 0 + or - t + or - T), where Xi(t) is a stationary stochastic process satisfying appropriate regularity and dependence conditions. Cases where the process (Xi(t)) is normal are discussed in detail. Related topics include point process properties of upcrossings of levels, sample path properties at such upcrossings, location of extremes, maxima and minima for two or more dependent processes, and properties of local extremes. GRA

N81-16818# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.

ASSESSING RISKS THROUGH THE DETERMINATION OF RARE EVENT PROBABILITIES Interim Report

Allan R. Sampson and Robert L. Smith Jul. 1980 48 p refs (Contract F49620-79-C-0161; AF Proj. 2304)

(AD-A092192; AFOSR-80-1165TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

We consider the problem in risk assessment of evaluating the probability of occurrence of rare, but potentially catastrophic, events. The lack of historical data due to the sheer novelty of the event makes conventional statistical approaches inappropriate. The problem is compounded by the complex multivariate dependencies that may exist across potential event sites. In order to evaluate the likelihood of one or more such catastrophic events occuring, we provide an information theoretic model for merging a decision maker's opinion with expert judgment. Also provided is a methodology for the reconciling of conflicting expert judgments. This merging approach is invariant to the decision maker's viewpoint in the limiting case of exceptionally rare events. These methods are applied to case studies in likelihood assessment of Liquid Natural Gas tanker spills and seismic induced light water nuclear reactor meltdowns. GRA

N81-16819# Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Ballistics Research Lab.

ON THE EFFICIENCY OF SENSITIVITY EXPERIMENTS ANALYZED BY THE MAXIMUM LIKELIHOOD ESTIMATION PROCEDURE UNDER THE CUMULATIVE NORMAL RESPONSE

Kali S. Banerjee Sep. 1980 31 p refs (DA Proj. 1L1-61102-AH-43)

(AD-A092349; AD-E430543; ARBRL-TR-02269) Avail: NTIS HC A03/MF A01 CSCL 12/1

While reviewing some of the implications of a small sample in a sensitivity experiment analyzed by the maximum likelihood estimation procedure under the cumulative normal response, this report provides a measure of efficiency of the experiment as a whole with reference to the estimation of mu and sigma. Such a measure of efficiency provides a perspective for a new look into the existing results as well as a direction for future planning. A design is suggested indicating the levels at which the observations have to be taken to maximize the efficiency of estimation. GRA

N81-16820# Princeton Univ., N. J. Dept. of Statistics.

COVERING THE CIRCLE WITH RANDOM ARCS OF RANDOM SIZES

Andrew F. Siegel and Lars Holst Sep. 1980 17 p refs Prepared in cooperation with Stanford Univ. (Contracts DAAG29-79-C-0205; N00014-76-C-0475)

(AD-A092659; TR-171-SER-2) Avail: NTIS HC A02/MF A01 CSCL 12/1

Consider the random uniform placement of a finite number of arcs on the circle, where the arc lengths are sampled from a distribution on (0,1). We provide exact formulae for the probability that the circle is completely covered and for the distribution of the number of uncovered gaps, extending Stevens' (1939) formulae for the case of fixed equal arc lengths. A special class of arc length distributions is considered, and exact probabilities of coverage are tabulated for the uniform distribution on (0,1). Some asymptotic results for the number of gaps are also given. GRA

N81-16821# Princeton Univ., N. J. Dept. of Statistics.

ROBUST REGRESSION USING REPEATED MEDIANS

Andrew F. Siegel Sep. 1980 19 p refs (Contract DAAG29-79-C-0205)

(AD-A092660; TR-172-SER-2; ARO-16669.2-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

The repeated median algorithm is a robustified U-statistic in which nested medians replace the single mean. Unlike many generalizations of the univariate median, repeated median estimates maintain the high 50% breakdown value and can resist the effects of outliers even when they comprise nearly half of the data. Because they are calculated directly, not iteratively, repeated median procedures can be used as starting values for iterative robust estimation methods. For bivariate linear regression with symmetric errors, repeated median estimates are unbiased and Fisher consistent, and their efficiency under Gaussian sampling can be comparable to the efficiency of the univariate median. GRA

N81-16822# Princeton Univ., N. J. Dept. of Statistics.

TEACHING ROBUST METHODS FOR EXPLORATORY DATA ANALYSIS

Andrew F. Siegel Oct. 1980 18 p refs (Contract DAAG29-79-C-0205)

(AD-A092661; TR-173-SER-2; ARO-16669.3-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper is an introduction to some of the ideas of robust statistical methods as was presented to the Fourth International Congress for Mathematical Education, session on Exploratory Data Analysis. Most statistical methods taught and used today are very sensitive to bad or atypical data and can give meaningless results in their presence. Robust methods protect against these undesirable effects and can be incorporated into the teaching of statistics at all levels of complexity. We discuss the need for robust methods to supplement (not replace) standard procedures, suggest some considerations regarding teaching, and review some of the fundamental concepts of robust estimation. GRA

N81-16823# Stanford Univ., Calif. Dept. of Statistics.

THE ANSCOMBE-WOODROOFE METHOD IN RENEWAL THEORY

Steven Paul Lalley 1 Sep. 1980 60 p refs (Contract N00014-77-C-0306; NR Proj. 042-373)

(AD-A092635; TR-11) Avail: NTIS HC A04/MF A01 CSCL 12/1

A probabilistic device deployed by Anscombe and Woodroofe is used to obtain a local limit theorem for a class of hitting times associated with transient one dimensional random walks.

Applications of this local limit theorem to ruin problems and to nonlinear renewal theory are given. GRA

N81-16824# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A MONTE CARLO INVESTIGATION OF ECONOMETRIC MODELS WITH FIXED AND STOCHASTIC REGRESSORS WHERE THE ERROR TERMS ARE AR(1) AND MA(1) Ph.D. Thesis - Colorado Univ.

Michael Stephen Anselmi 1980 99 p refs
(AD-A092524; AFIT-CI-80-5D) Avail: NTIS HC A05/MF A01 CSCL 05/3

A Monte Carlo study of four specialized regression procedures is reported. Two of the procedures are designed for a simple linear econometric model while the other two procedures are designed for a single period lagged endogenous variable and single exogenous variable econometric model. For the simple linear model, the small sample properties of the Pesaran procedure, designed for an MA(1) error term, and the Beach-MacKinnon procedure, designed for an AR(1) error term, are compared against the small sample properties of OLS and against those of the Prais-Winston procedure. For the lagged endogenous model, the small sample properties of the Zellner-Geisel procedure, designed for an MA(1) error term, and the Wallis procedure, designed for an AR(1) error term, are likewise compared against the small sample properties of OLS and of Prais-Winston. In addition, the power of the Durbin-Watson d test is analyzed for both models and the Durbin h and the McNown tests are analyzed for the lagged endogenous model. GRA

N81-16825# Naval Postgraduate School, Monterey, Calif. Dept. of Operations Research.

METHODOLOGY FOR DETERMINING SAMPLING INTERVALS

H. J. Larson and T. Jayachandran Nov. 1980 35 p refs
(AD-A092591; NPS53-81-001) Avail: NTIS HC A03/MF A01 CSCL 12/1

A new methodology for the determination of sampling intervals to be used with the spectrometric oil analysis program has been developed. The methodology has been tested with preliminary data and appears to perform well. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N81-16826*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY. AIDS 3 EVALUATION REPORT. VOLUME 1: COMPENDIUM

B. D. L. Mulhall 15 Nov. 1980 135 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163903; JPL-Pub-80-79-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 12B

The primary features of the overall study are encompassed and an evaluation of an automation system is presented. Objectives of the study are described, methods of evaluation are summarized and conclusions about the system's feasibility are presented. Also included is a brief history of fingerprint automation activities within the FBI, the organization of the FBI, a bibliography of documents and records, a data dictionary and a reference set of all of the transparencies presented throughout the study. T.M.

N81-16827*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY. AIDS 3 EVALUATION REPORT. VOLUME 2: TECHNICAL FEASIBILITY

B. D. L. Mulhall 15 Aug. 1980 50 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163904; JPL-Pub-80-79-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 12B

The results of this effort are presented in a manner for use by both the AIDS 3 Operational and Economic Feasibility subtasks as well as the Development of Alternative subtask. The approach taken was to identify the major functions that appear in AIDS 3 and then to determine which technologies would be needed for support. The technologies were then examined from the point of view of reliability, throughput, security, availability, cost and possible future trends. Whenever possible graphs are given to indicate projected costs of rapidly changing technologies. T.M.

N81-16828*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY. AIDS 3 EVALUATION REPORT. VOLUME 3: OPERATIONAL FEASIBILITY

B. D. L. Mulhall 15 Nov. 1980 185 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163905; JPL-Pub-80-79-Vol-3) Avail: NTIS HC A09/MF A01 CSCL 12B

An evaluation is presented which is defined as the adequacy of system design with known functional and performance requirements. The proposed Rockwell International AIDS 3 card, document and data flow are presented to summarize the concepts involved and the relationships between functions. The analysis and evaluation includes a study of system capability, processing rates, search requirements and response accuracy as well as a consideration of operational components and hardware integration. Results indicate that the AIDS 3 System concept is operationally feasible if production capacity is slightly enhanced but that operational complexity, hardware integration and a lack of conceptual data pertinent to some of the functions are areas of concern. T.M.

N81-16829*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY. AIDS 3 EVALUATION REPORT. VOLUME 4: ECONOMIC FEASIBILITY

B. D. L. Mulhall 15 Nov. 1980 97 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(JPL-Pub-80-79-Vol-4; NASA-CR-163906) Avail: NTIS HC A05/MF A01 CSCL 12B

The results of the economic analysis of the AIDS 3 system design are presented. AIDS 3 evaluated a set of economic feasibility measures including life cycle cost, implementation cost, annual operating expenditures and annual capital expenditures. The economic feasibility of AIDS 3 was determined by comparing the evaluated measures with the same measures, where applicable, evaluated for the current system. A set of future work load scenarios was constructed using JPL's environmental evaluation study of the fingerprint identification system. AIDS 3 and the current system were evaluated for each of the economic feasibility measures for each of the work load scenarios. They were compared for a set of performance measures, including response time and accuracy, and for a set of cost/benefit ratios, including cost per transaction and cost per technical search. Benefit measures related to the economic feasibility of the system are also presented, including the required number of employees and the required employee skill mix. T.M.

N81-16830*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY: AIDS 3 EVALUATION REPORT. VOLUME 5: CURRENT SYSTEM EVALUATION

B. D. L. Mulhall 15 Nov. 1980 151 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163907; JPL-Pub-80-79-Vol-5) Avail: NTIS HC A08/MF A01 CSCL 12B

The performance, costs, organization and other characteristics of both the manual system and AIDS 2 were used to establish a baseline case. The results of the evaluation are to be used to determine the feasibility of the AIDS 3 System, as well as provide a basis for ranking alternative systems during the second phase of the JPL study. The results of the study were tabulated by

subject, scope and methods, providing a descriptive, quantitative and qualitative analysis of the current operating systems employed by the FBI Identification Division. T.M.

N81-16831*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY: AIDS 3 EVALUATION REPORT. VOLUME 6: ENVIRONMENTAL ANALYSIS
B. D. L. Mulhall 15 Nov. 1980 108 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163908; JPL-Pub-80-79-Vol-6) Avail: NTIS HC A06/MF A01 CSCL 12B

The results of the analysis of the external environment of the FBI Fingerprint Identification Division are presented. Possible trends in the future environment of the Division that may have an effect on the work load were projected to determine if future work load will lie within the capability range of the proposed new system, AIDS 3. Two working models of the environment were developed, the internal and external model, and from these scenarios the projection of possible future work load volume and mixture was developed. Possible drivers of work load change were identified and assessed for upper and lower bounds of effects. Data used for the study were derived from historical information, analysis of the current situation and from interviews with various agencies who are users of or stakeholders in the present system. T.M.

N81-16832*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY: AIDS 3 EVALUATION REPORT. VOLUME 7: TOP DOWN FUNCTIONAL ANALYSIS
B. D. L. Mulhall 15 Aug. 1980 28 p refs Sponsored in part by the Dept. of Justice
(Contract NAS7-100)
(JPL-Pub-80-79-Vol-7; NASA-CR-163909) Avail: NTIS HC A03/MF A01 CSCL 12B

The functions are identified and described in chart form as a tree in which the basic functions, to 'Provide National Identification Service,' are shown at the top. The lower levels of the tree branch out to indicate functions and sub-functions. Symbols are used to indicate whether or not a function was automated in the AIDS 1 or 2 system or is planned to be automated in the AIDS 3 system. The tree chart is shown in detail. T.M.

N81-16833*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY: AIDS 3 EVALUATION REPORT. VOLUME 8: MEASURES OF EFFECTIVENESS
B. D. L. Mulhall 15 Nov. 1980 47 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163910; JPL-Pub-80-79-Vol-8) Avail: NTIS HC A03/MF A01 CSCL 12B

The development of both quantitative criteria that were used to evaluate conceptional systems for automating the functions for the FBI Identification Division is described. Specific alternative systems for automation were compared by using these developed criteria, defined as Measures of Effectiveness (MOE), to gauge system's performance in attempting to achieve certain goals. The MOE, essentially measurement tools that were developed through the combination of suitable parameters, pertain to each conceivable area of system operation. The methods and approaches used, both in selecting the parameters and in using the resulting MOE, are described. T.M.

N81-16834*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY: AIDS 3 EVALUATION REPORT. VOLUME 9: FUNCTIONAL REQUIREMENTS
15 Aug. 1980 48 p refs Sponsored in part by the Dept. of Justice 9 Vol.
(Contract NAS7-100)
(NASA-CR-163911; JPL-Pub-80-79-Vol-9) Avail: NTIS HC A03/MF A01 CSCL 12/8

The current system and subsystem used by the Identification Division are described. System constraints that dictate the system environment are discussed and boundaries within which solutions must be found are described. The functional requirements were related to the performance requirements. These performance requirements were then related to their applicable subsystems. The flow of data, documents, or other pieces of information from one subsystem to another or from the external world into the identification system is described. Requirements and design standards for a computer based system are presented. T.M.

N81-16835*# Fort Lewis A&M Coll., Durango, Colo.
SPACECRAFT UTILITY AND THE DEVELOPMENT OF CONFIDENCE INTERVALS FOR CRITICALITY OF ANOMALIES Interim Report, Jan. - Oct. 1980
Raymond E. Williams
Nov. 1980 25 p refs
(Grant NAG5-1)
(NASA-CR-160090) Avail: NTIS HC A02/MF A01 CSCL 12B

The concept of spacecraft utility, a measure of its performance in orbit, is discussed and its formulation is described. Performance is defined in terms of the malfunctions that occur and the criticality to the mission of these malfunctions. Different approaches to establishing average or expected values of criticality are discussed and confidence intervals are developed for parameters used in the computation of utility. Author

N81-16836# Wright State Univ., Dayton, Ohio. Coll. of Business and Administration.
THE STUDY OF PRODUCTION LEADTIME FORECASTING MODELS Final Report
Michael J. Cleary 1 Oct. 1980 44 p refs
(Contract F49620-79-C-0170; AF Proj. 2304)
(AD-A091970; AFOSR-80-1121TR) Avail: NTIS HC A03/MF A01 CSCL 12/2

Production leadtime (PLT) has experienced great fluctuations over the last few years. This can have a great effect upon the Inventory System of the Air Force. Presently the Air Force uses a forecasting model which assumes that PLT in the next time period is equal to PLT in the last time period. In order to improve upon this method, this study investigated both the use of ARMA and Smoothing Models for the prediction of PLT. The ARMA Model was eliminated as an effective prediction model for PLT. This was because the average number of data points was well below the minimum needed to make good forecasts using ARMA. An investigation of various smoothing models suggests that a significant improvement in forecasting can be achieved by using these models instead of the present Air Force Model. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N81-16837# Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.
ATTRACTIVITY PROPERTIES OF ALPHA-CONTRACTIONS Interim Report
Paul Massatt 12 Aug. 1980 15 p refs
(Contract DAAG29-79-C-0161; Grant AF-AFOSR-3092-76; AF Proj. 2304)
(AD-A091975; AFOSR-80-1137TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is known that if T' X yields X is completely continuous where X is a Banach space, then point dissipative and compact dissipative are equivalent, and imply the existence of a maximal compact invariant set which is uniformly asymptotically stable and attracts bounded sets uniformly. If T is an alpha contraction, it is not known whether point dissipative and compact dissipative are equivalent. However, T is compact dissipative, then there exists a maximal compact invariant set which is uniformly asymptotically stable and attracts neighborhoods of compact sets uniformly. Since, in practice, it is much easier to verify that a

map is point dissipative rather than compact dissipative, it is desirable to say more about the limiting behavior when T is only assumed to be point dissipative. In this paper, we show, with the addition of only a few general assumptions, that point dissipative and compact dissipative are equivalent. The assumptions seem to be general enough to include almost all of the practical applications. Applications are given, or referenced, to stable neutral functional differential equations, retarded functional differential equations of infinite delay, and strongly damped nonlinear wave equations. GRA

N81-16838# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.

ASYMPTOTIC DISTRIBUTIONS OF FUNCTIONS OF THE EIGENVALUES OF THE REAL AND COMPLEX NONCENTRAL WISHART MATRICES Interim Report

C. Fang and P. R. Krishnaiah Jul. 1980 41 p refs
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A092191; TR-80-11; AFOSR-80-1164TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper, the authors derived asymptotic expressions for the joint densities of various functions of the noncentral real and complex Wishart matrices. Applications of the above results are also discussed in the area of reduction of dimensionality and testing for the structure of interaction in two-way classification with one observation per cell. GRA

N81-16839# Pittsburgh Univ., Pa. Inst. for Statistics and Applications.

DISTRIBUTIONS OF SOME MATRIX VARIATES AND LATENT ROOTS IN MULTIVARIATE BEHRENS-FISHER DISCRIMINANT ANALYSIS Interim Report

Yasuko Chikuse Sep. 1980 18 p refs
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A091960; AFOSR-80-1166TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper, it is shown that some distribution of the matrix variates and latent roots arising in the multivariate Behrens-Fisher discriminant problem can be explicitly expressed in terms of the invariant polynomials with two matrix arguments, extending the zonal polynomials of matrix argument. GRA

N81-16840# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

NONLINEAR SEMIGROUP FOR CONTROLLED PARTIALLY OBSERVED DIFFUSIONS Interim Report

Wendell H. Fleming 21 Aug. 1980 40 p refs
(Grants AF-AFOSR-3063-76; NSF MCS-79-03554; AF Proj. 2304)
(AD-A092188; AFOSR-80-1136TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper a 'separated' control problem associated with controlled, partially observed diffusion processes is considered. The state in the separated problem is an unnormalized conditional distribution measure. The corresponding Nisio nonlinear semigroup associated with the separated problem is found. GRA

N81-16841# Georgetown Univ., Washington, D.C. Inst. for Management Science and Engineering.

CONVERGENCE THEORY FOR UNCONSTRAINED MINIMIZATION

Garth P. McCormick 30 Sep. 1980 20 p refs
(Contracts DAAG29-79-C-0729; N00014-75-C-0729)
(AD-A092254; SERIAL-T-431) Avail: NTIS HC A02/MF A01 CSCL 12/1

Convergence theory for unconstrained minimization centers on proving which characteristics hold at point of accumulation of minimizing sequences generated by unconstrained minimization algorithms. To a great extent, convergence proofs for particular algorithms have common elements. In this paper, some results have been synthesized and put in a general context. Some applications of the theory are included. GRA

N81-16842# Indiana Univ. at Bloomington. Dept. of Mathematics.

ON SCHUR OPTIMALITY Interim Report

Gregory M. Constantine Mar. 1980 26 p refs
(Contract AF-AFOSR-3050-76; AF Proj. 2304)
(AD-A092185; AFOSR-80-1117TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Schur-optimality is defined (in the general setting of a linear model) as a generalization of the well-known D, A and E-optimality criteria. Techniques to establish Schur-optimality are outlined, based chiefly on a process of averaging information matrices and on vector majorization. A design with a completely symmetric information matrix of maximal trace and exactly two distinct nonzero eigenvalues is proved Schur-better than a large class of designs. One description of a subcollection of designs over which Schur-optimality holds is given only in terms of the diagonal elements of the information matrices. Consequences of this are then examined in the setting on block designs. GRA

N81-16843# Illinois Univ. at Chicago Circle, Chicago. Dept. of Mathematics.

CONSTRUCTION OF PBIB DESIGNS WITH TRIANGULAR AND L2 SCHEMES Interim Report

G. M. Constantine and A. Hedayat Sep. 1980 13 p refs
(Grant AF-AFOSR-3050-76)
(AD-A092190; AFOSR-80-1155TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Simple methods of construction lead to families of PBIB designs with triangular and L sub 2 schemes. The construction can be carried out in a s dimensions to obtain PBOB designs with at most s associate classes. A family of such PBIB designs (indexed by the block size) has the desirable statistical property that a pair of distinct varieties appears in at most one block. GRA

N81-16844# Maryland Univ. Baltimore County, Catonsville. Dept. of Mathematics.

DETECTION, ESTIMATION, AND CONTROL ON GROUP MANIFOLDS Final Scientific Report, 1 Jul. 1979 - 31 Jul. 1980

James T. Lo 31 Jul. 1980 10 p refs
(Contract F49620-79-C-0186; AF Proj. 2304)
(AD-A092386; AFOSR-TR-1055TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

An optimal estimation scheme for continuous-time rotational processes with one degree of freedom was obtained. The estimation problem for continuous-time rotational processes with three degrees of freedom turns out to be rather difficult. Many attempts were made by the principal investigation in the past few years on the problem. While these attempts produced minimal results, many crucial issues have been placed in perspective. Because of the theoretical and practical importance of the problem, a concentrated effort was finally made during the report period to study these issues. GRA

N81-16845# California Univ., Berkeley. Electronics Research Lab.

RESIDUAL BOUNDS ON APPROXIMATE EIGENSYSTEMS OF NONNORMAL MATRICES

B. N. Parlett and E. Jiang 5 Sep. 1980 28 p refs
(Contract N00014-76-C-0013)
(AD-A092577; UCB/ERL-M80/39) Avail: NTIS HC A03/MF A01 CSCL 12/1

A problem is presented wherein the goal is to compute some or all of the eigenvalues of a square matrix B which is not symmetric. There is on hand an approximate column eigenvector x, an approximate row eigenvector y(*), and a number gamma. In addition, the norms of their residual vectors, r and s(*), are computed where r is congruent to Bx-x gamma and s(*) is congruent to y(*)B-gamma y(*). It turns out that r/x < or = 0.00001 B and s(*)/y(*)< or = 0.000001 B. The adequacy of gamma as an approximate eigenvalue of B is discussed. The Rayleigh-Ritz procedure and the computation of error bounds are addressed. M.G.

N81-16846# Stanford Univ., Calif. Dept. of Statistics.

COCHRAN'S THEOREM, RANK ADDITIVITY, AND TRIPOTENT MATRICES

T. W. Anderson and George P. H. Styan (McGill Univ.) Aug. 1980 42 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A092636; TR-43) Avail: NTIS HC A03/MF A01 CSCL 12/1

Our purpose in this paper is to review various extensions of Cochran's Theorem in a bibliographic and historical perspective, with special emphasis on matrix-theoretic analogues. while we present over 30 references, we note that Scarowsky (1973) has a rather complete discussion and bibliography on the distribution of quadratic forms in normal random variables. GRA

N81-16847# Stanford Univ., Calif. Dept. of Statistics.
LONG COMMON SUBSEQUENCES AND THE PROXIMITY OF TWO RANDOM STRINGS
J. Michael Steele 6 Nov. 1980 19 p refs
(Contract N00014-76-C-0475; NR Proj. 042-267)
(AD-A092610; TR-293) Avail: NTIS HC A02/MF A01 CSCL 12/1

Let (x(1), x(2),. . ., x(n)) and (x(1), x(2),. . ., x(n)) be two strings from an alphabet a, and let L(n) denote their longest common subsequence. The probabilistic behavior of L(n) is studied under various probability models for the x and x'st strings. GRA

N81-16848# Stanford Univ., Calif. Dept. of Statistics.
NON-LINEAR RENEWAL THEORY FOR LATTICE RANDOM WALKS
Steven P. Lalley 1 Jun. 1980 16 p refs
(Contract N00014-77-C-0306; NR Proj. 042-373)
(AD-A092598; TR-9) Avail: NTIS HC A02/MF A01 CSCL 12/1

Renewal theorems are obtained for a class of perturbed arithmetic random walks. An application to the study of fixed-width confidence intervals is discussed. GRA

N81-16849# Stanford Univ., Calif. Dept. of Statistics.
ON GENERALIZATIONS OF COCHRAN'S THEOREM AND PROJECTION MATRICES
Akimichi Takemura Aug. 1980 30 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A092595; TR-44) Avail: NTIS HC A03/MF A01 CSCL 12/1

Generalizations of Cochran's theorem including (1) non-symmetric matrices and (2) r-potent matrices are proved by consistent use of projection matrices. Decomposition of diagonalizable matrices into projections to eigenspaces (or spectral decomposition) and its relation to Cochran-type decomposition are studied. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

No abstracts in this category.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N81-16850 British Broadcasting Corp., Kingswood (England).
AN INVESTIGATION INTO THE MECHANISM OF SOUND-ENERGY ABSORPTION IN A LOW-FREQUENCY MODULAR ABSORBER
R. Walker and K. E. Randall Nov. 1980 26 p refs
(BBC-RD-1980/12) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The behavior of a widely used type of modular, low-frequency acoustic treatment was investigated. A region of spurious sound-energy absorption in the middle part of the audio frequency range, which was originally acceptable, has become more significant in units made since the prototypes were tested in 1969. This has caused excessive absorption in treated rooms in this range of frequencies. A theoretical study based on the supposed behavior of this absorber failed to identify the cause, showing that the supposed behavior was erroneous. Experimental work on a number of modifications to the original design showed that the spurious absorption was caused by damped vibrations of the main structure of the modules. It also showed that the wanted low-frequency absorption resulted from mechanical vibrations of the front-panel, rather than from an acoustic ('Helmholtz') resonance, as had previously been thought. A.R.H.

N81-16851*# United Technologies Research Center, East Hartford, Conn.
REFRACTION AND SCATTERING OF SOUND BY A SHEAR LAYER Final Report
Robert H. Schlinker and Roy K. Amiet Washington NASA Dec. 1980 192 p refs
(Contract NAS1-15339)
(NASA-CR-3371) Avail: NTIS HC A09/MF A01 CSCL 20A

The angle and amplitude changes for acoustic waves refracted by a circular open jet shear layer were determined. The generalized refraction theory was assessed experimentally for on axis and off axis acoustic source locations as source frequency varied from 1 kHz to 10 kHz and free stream Mach number varied from 0.1 to 0.4. Angle and amplitude changes across the shear layer show good agreement with theory. Experiments confirm that the refraction theory is independent of shear layer thickness, acoustic source frequency, and source type. A generalized theory is, thus, available for correcting far field noise data acquired in open jet test facilities. The effect of discrete tone scattering by the open jet turbulent shear layer was also studied. Scattering effects were investigated over the same Mach number range as frequency varied from 5 kHz to 15 kHz. Attenuation of discrete tone amplitude and tone broadening were measured as a function of acoustic source position and radiation angle. Scattering was found to be stronger at angles close to the open jet axis than at 90 deg, and becomes stronger as the acoustic source position shifts downstream. A scattering analysis provided an estimate of the onset of discrete tone scattering. A.R.H.

N81-16852*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
A DESIGN PROCEDURE FOR FAN INFLOW CONTROL STRUCTURES Final Report
M. R. Gedge Sep. 1980 203 p refs Prepared in cooperation with Boeing Commercial Airplane Co., Seattle
(Contract NAS1-15085)
(NASA-CR-165625) Avail: NTIS HC A10/MF A01 CSCL 20A

Significant differences exist in the noise generated by engine in flight and engines operating on the test stand. It was observed that these differences can be reduced by use of an inflow control structure (ICS) in the static test configuration. The results of the second phase of a three phase program are described and the results of a test program conducted to assess and modify various theoretical models, leading to the development of an ICS design system is summarized. E.D.K.

N81-16853*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
STUDIES ON PROPER SIMULATION DURING STATIC TESTING OF FORWARD SPEED EFFECTS ON FAN NOISE Final Report
A. A. Peracchio, U. W. Ganz, M. R. Gedge, and K. Robbins Sep. 1980 103 p refs Prepared in cooperation with Boeing Commercial Airplane Co., Seattle
(Contract NAS1-15085)
(NASA-CR-165626) Avail: NTIS HC A06/MF A01 CSCL 20A

Significant differences exist in the noise generated by engines in flight and engines operating on the test stand. It was observed that these differences can be reduced by the use of an inflow control structure (ICS) in the static test configuration. The results of the third phase of a three phase program are described. The work performed in the first two phases which dealt with the development of a model for atmospheric turbulence, studies of fan noise generated by rotor turbulence interaction, and the development of an inflow control structure design system are summarized. The final phase of the program covers procedures for performing static testing with an ICS projecting the resulting static test data to actual flight test data. Included is a procedures

report which covers the design system and techniques for static testing and projecting the static data to flight. E.D.K.

N81-16854*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
ACOUSTIC AND AERODYNAMIC PERFORMANCE INVESTIGATION OF INVERTED VELOCITY PROFILE COANNULAR PLUG NOZZLES Final Report
P. R. Knott, J. T. Blozy, and P. S. Staid Washington NASA Feb. 1981 259 p refs
(Contract NAS3-19777)
(NASA-CR-3149; R79AEG388) Avail: NTIS HC A12/MF A01 CSCL 20A

The results of model scale parametric static and wind tunnel aerodynamic performance tests on unsuppressed coannular plug nozzle configurations with inverted velocity profile are discussed. The nozzle configurations are high-radius-ratio coannular plug nozzles applicable to dual-stream exhaust systems typical of a variable cycle engine for Advanced Supersonic Transport application. In all, seven acoustic models and eight aerodynamic performance models were tested. The nozzle geometric variables included outer stream radius ratio, inner stream to outer stream ratio, and inner stream plug shape. When compared to a conical nozzle at the same specific thrust, the results of the static acoustic tests with the coannular nozzles showed noise reductions of up to 7 PNdB. Extensive data analysis showed that the overall acoustic results can be well correlated using the mixed stream velocity and the mixed stream density. Results also showed that suppression levels are geometry and flow regulation dependent with the outer stream radius ratio, inner stream-to-outer stream velocity ratio and inner stream velocity ratio and inner stream plug shape, as the primary suppression parameters. In addition, high-radius ratio coannular plug nozzles were found to yield shock associated noise level reductions relative to a conical nozzle. The wind tunnel aerodynamic tests showed that static and simulated flight thrust coefficient at typical takeoff conditions are quite good - up to 0.98 at static conditions and 0.974 at a takeoff Mach number of 0.36. At low inner stream flow conditions significant thrust loss was observed. Using an inner stream conical plug resulted in 1% to 2% higher performance levels than nozzle geometries using a bent inner plug. M.G.

N81-16855# Wisconsin-Milwaukee Univ., Milwaukee. Dept. of Physics.
CHARACTERIZATION OF SUPERCONDUCTORS BY SURFACE WAVE TECHNIQUES Final Report, 1 Oct. 1975 - 30 Sep. 1980
Mcises Levy 28 Oct. 1980 31 p refs
(Grant AF-AFOSR-2893-76)
(AD-A092387; AFOSR-80-1173TR) Avail: NTIS HC A03/MF A01 CSCL 20/3

The objective of this research project was to initiate a program to characterize superconductors by means of ultrasonic surface waves. Initially thin films Beta-tungsten and rocksalt superconductors were investigated. Measurements on Nb3Ge determined the superconducting fraction of the film as a function of temperature and the electron mean free path. Measurements on Nb3Sn determined the temperature dependent of superconducting energy gap and the upper critical field of the film. Measurements on several NbN films appear to indicate that there is a new interaction mechanism between the surface wave and the superconducting excitations in this rocksalt structure compound. The initial phase of the study on the effect of nickel films on the propagation of ultrasonic surface waves has been completed. Ultrasonic measurements have been performed on a polycrystalline sample of the ternary reentrant superconductor ErRh4B4 as a function of temperature where it is superconducting. Evidence is obtained for characterizing this superconductor as type 2/1 and for the fact that the transverse staggered susceptibility is screened by superconducting currents in the mixed state. Ultrasonic measurements have been performed in the superconducting and mixed states of bulk superconductors. GRA

N81-16856# Tennessee Univ., Knoxville. Ultrasonics Lab.
RAYLEIGH REFLECTIONS AND NONLINEAR ACOUSTICS OF SOLIDS Interim Report
M. A. Breazeale Oct. 1980 72 p refs Sponsored in part by the International Research and Exchanges Board
(Contract N00014-76-C-0177; NR Proj. 384-306)
(AD-A092603; TR-18) Avail: NTIS HC A04/MF A01 CSCL 20/1

Schlierken studies of ultrasonic waves, and nonlinear acoustics of solids are addressed. A goniometer for use in a Schlieren system for visualization of ultrasonic waves in liquids is described. The goniometer is used to obtain Schlieren photographs of leaky Rayleigh waves excited on an Al2O3 layer on a stainless steel reflector immersed in water, showing that the Rayleigh wave velocity in this case is less than that of either a water Al2O3 layer or a water stainless steel layer. Also investigated are: (1) nonlinearity parameters and third order elastic constants of copper between 300 and 3 K; (2) measurement of nonlinearity parameters in small solid samples by the harmonic generation technique; (3) relationship between solid nonlinearity parameters and thermodynamic Gruneisen parameters; and (4) quantum mechanical theory of nonlinear interaction of ultrasonic waves. M.G.

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N81-16857 Ohio State Univ., Columbus.
PULSED LASER AND DIODE LASER SPECTROSCOPY OF SMALL MOLECULES Ph.D. Thesis
Palash Kusum Parijat Das 1980 236 p
Avail: Univ. Microfilms Order No. 8100135

Several small molecules are studied by using the techniques of pulsed laser and tunable semiconductor diode laser spectroscopy. A pulsed multigas laser and pulsed line tunable CO2 laser were constructed. Line positions, molecular constants, line shapes, and line strengths of several molecules having their bands between 12-15 microns were determined. Linear molecules like CO2, HCN, C2H2 and some of their isotopes, all occurring in their natural abundences, were studied. The Nu sub 2 band of HCN is shown to provide reliable wavelength standards in the 16-16 micron region. A set of internally consistent equations was developed connecting the various rovibrational levels of linear molecules to be used in high resolution infrared spectroscopy. Symmetric top and asymmetric top molecules, viz (12)CH3I, (3)CH3I, NO2, O3, and CH2DI were studied. Molecular constants, line strengths, and line shapes were determined. Line strengths of several lines of the Nu sub 4 band of (70)GeH4, (72)GeH4, (73)GeH4, (74)GeH4, and (76)GeH4 were determined. Transition moments were also determined. The effect of Coniolis resonance between the Nu sub 3 and Nu sub 4 bands on line strengths of the Nu sub 4 band was studied. Dissert. Abstr.

N81-16858# Aerodyne Research, Inc., Bedford, Mass.
A QUALITATIVE THEORETICAL CHARACTERIZATION OF HIGH ENERGY EXCITATION CROSS SECTIONS
Michael B. Faist Hanscom AFB, Mass. AFGL May 1980 25 p refs
(Contract F19628-78-C-0145; AF Proj. 2123)
(AD-A092061; ARI-RR-174; SR-2; AFGL-TR-80-0049) Avail: NTIS HC A02/MF A01 CSCL 07/4

An information theoretic approach is used to calculate the cross sections for the vibrational excitation of H2O and CO2 by atomic oxygen. The calculational results are shown to compare quite well with existing experimental data. GRA

N81-16859# California Univ., San Diego. Dept. of Chemistry.
MOLECULAR DYNAMICS AND SPECTRA 1: DIATOMIC ROTATION AND VIBRATION
Kent R. Wilson and Peter H. Berens Nov. 1980 27 p refs Submitted for publication
(Contract N00014-78-C-0325)
(AD-A092317; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

The pure rotational and vibrational-rotational absorption bands for a diatomic are calculated directly from classical molecular dynamics, classical linear response theory and classical statistical mechanical ensemble averaging with the use of simple quantum

corrections. The experimental spectral band intensities and contours are well reproduced for CO from dilute gas phase through solution in compressed Ar to solution in liquid Ar by these 'Newtonian' classical spectral calculations. The typical evolution seen in vibrational spectra from multiple-peaked gas phase bands to single-peaked solution bands is observed. The 'Newtonian' gas phase calculations also match quantum and correspondence principle classical spectral calculations. This molecular dynamic approach may be applied to compute the spectra of complex molecules or of liquids for which a normal mode analysis may be impractical, and may also be extended to nonequilibrium systems, for example to compute transient vibrational spectra during chemical reactions. GRA

N81-16860# Williams Coll., Williamstown, Mass.
RESONANCE STUDIES OF H ATOMS INTERACTING WITH LIQUID HELIUM SURFACES Annual Summary Report
Stuart B. Crampton Oct. 1980 5 p
(Contract N00014-80-C-0240)
(AD-A092624) Avail: NTIS HC A02/MF A01 CSCL 07/4

Techniques developed by this investigator for studying the hyperfine resonance of gaseous atomic hydrogen in storage bulbs under liquid helium will be extended downwards in temperature to 0.5 K, in order to study the interactions of H atoms with superfluid liquid helium surfaces and with each other while adsorbed on the liquid helium surfaces. A liquid helium temperature state-selected H atom beam will be developed and used to study the feasibility of hydrogen maser oscillation at liquid helium temperature. GRA

N81-16861# Johns Hopkins Univ., Baltimore, Md.
STUDIES IN HOT ATOM AND RADIATION CHEMISTRY Progress Report, 1 Dec. 1979 - 30 Nov. 1980
Walter S. Koski Sep. 1980 15 p refs
(Contract EY-76-S-02-3283)
(DOE/ER-03283/31) Avail: NTIS HC A02/MF A01

Results on the reactive scattering of B(+) (3 P u) by D2 and on the state of B(+) are summarized. The ionic aspect of the Br ethane hot atom system is being investigated using beam techniques. It is found that there is no direct reaction Br(+) with ethane which can explain the thermal ionic yield of CH3Br reported by hot atom chemists for the Br ethane hot atom system. Likewise, no satisfactory explanation exists for the dependence of the thermal ionic yield of CH3Br on moderator mole fraction. Studies of the collisions of Br(+) with Kr (which is used as a moderator in hot atom systems) shows that ions such as BrKr(+) are formed. Electron irradiation of CH3Br-Kr mixtures shows that CH3BrKr(+) is formed in good yield. Electron irradiation of Br2Kr mixtures shows that ions such as Br(Kr)n + are formed. Such ions can be produced in the Kr moderated Br ethane hot atom system and can explain the thermal ionic yield of Ch3Br and its dependence on Kr pressure.
Author

N81-16862# Texas Univ., Austin. Fusion Research Center.
SIMULATIONS OF THE RUNAWAY ELECTRON DISTRIBUTION
J. C. Wiley, Duk-in Choi, and Wendell Horton Mar. 1980 56 p refs
(DOE/ET-53036/14; FRCR-210) Avail: NTIS HC A04/MF A01

The time evolution of the electron distribution function was followed from an initial Maxwellian to the quasi-steady state runaway distribution as a function of E/E sub D and Z using a new two dimensional Fokker-Planck code. The electron distribution rate, the current density along with the fraction of Ohmic power directed to the runaways, and the perpendicular and parallel temperatures of the high energy distributions. A simple parameterization of the high energy distribution is given and was used to investigate the high frequency runaway instability for the infinite uniform plasma. T.M.

N81-16863# Illinois Univ. at Urbana-Champaign.
DIFFRACTIVE HADRONIC PRODUCTION OF D MESONS
L. J. Koester, G. Alverson, G. Ascoli, D. Bender, J. Cooper, L. E. Holloway, U. E. Kruse, W. W. Mackay, R. D. Sard, M. Shupe et al 1980 11 p refs Presented at 20th Intern. Conf. on High Energy Phys., Madison, Wis., 17-23 Jul. 1980 Prepared in cooperation with Fermilab, Batavia, Ill., Harvard Univ., Cambridge, Mass., Oxford Univ., England and Tufts Univ., Medford, Mass.
(Contract DE-AC02-76ER-01195)
(CONF-800724-55) Avail: NTIS HC A02/MF A01

A search for charmed D mesons was made with a 217 GeV neg proton beam on a liquid hydrogen target. The Chicago Cyclotron Spectrometer at Fermilab was used to analyze the hadronic decay of a D meson in coincidence with a prompt muon and a recoil proton. A total of 50 plus or minus events were observed with equal numbers in two channels. Some of the cuts selected diffractive events. When these cuts were removed the signal remained the same, although the background was greatly increased. The Feyman X and angular distributions were consistent with diffractive production. A diffractive model yielded a cross section of (6-10) plus or minus 4ub. Author

N81-16864# Los Alamos Scientific Lab., N. Mex. Theoretical Div.
CAN MASSLESS NEUTRINOS DOMINATE THE UNIVERSE?
Edward W. Kolb 19 Nov. 1980 16 p refs Presented at Wisconsin Neutrino Mass Miniconf. and Workshop, Cable, 2-4 Oct. 1980 Submitted for publication
(Contract W-7405-eng-36)
(LA-UR-80-3380; CONF-8010127-2) Avail: NTIS HC A02/MF A01

The restrictions from cosmological considerations on masses and lifetimes of neutral, weakly interacting fermions are reviewed. In particular, the possibility of the massless decay products of a heavy neutrino dominating the energy density of the present universe is discussed. Author

N81-16865# Vanderbilt Univ., Nashville, Tenn. Dept. of Computer Science.
THEORETICAL STUDIES OF ATOMIC TRANSITIONS Progress Report, 15 Mar. 1980 - 14 Mar. 1981
Charlotte Froese Fischer 1981 12 p refs
(Contract DE-AS05-80ER-10618)
(DOE/ER-10618/1) Avail: NTIS HC A02/MF A01

The transitional probability (or f value) trends along an isoelectric sequence were investigated. Calculations of atomic energy levels and studies of transitional probability trends were performed for several cases including f value trends in the presence of level crossings and lifetimes of levels in the A1 I sequence. An evaluation of experimental f values reported to high accuracy is presented. T.M.

N81-16866# Los Alamos Scientific Lab., N. Mex.
H(-)ION SOURCE RESEARCH AT LOS ALAMOS
Paul Allison, H. Vernon Smith, Jr., and Joseph D. Sherman 1980 8 p refs Presented at 2nd Intern. Symp. on the Production and Neutralization of Negative Hydrogen Ions and Beams, Upton, N.Y., 6-10 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2841; CONF-801068-7) Avail: NTIS HC A02/MF A01

Up 10 160 H(-) ions were extracted at 20 kV from a 10 by 0.5 sq mm slit in a Penning surface plasma source. Typically, 70% of the beam can be transported through a bending magnet to a Faraday cup or emittance scanner. Up to 90% transmission was observed from some neutralizing gases. Average and pulsed cesium flows from the source were measured with a surface ionization gauge. Operating parameters of the source and measurements of the emittance are reported. J.M.S.

N81-16867# Ames Lab., Iowa.
HYDRIDES EXAMINED BY NUCLEAR MAGNETIC RESONANCE
R. G. Barnes 1980 19 p refs Presented at Ann. Meeting of Mater. Res. Soc., Boston, 16-21 Nov. 1980
(Contract W-7405-eng-82)
(IS-M-307; CONF-801124-37) Avail: NTIS HC A02/MF A01

The capabilities of nuclear magnetic resonance (NMR) methods in studying metal hydride systems are demonstrated. Specific topics covered include crystal structure, atom locations, electronic structure, changes that occur in these systems due to structural and electronic phase transitions and hydrogen diffusion.

A variety of experimental techniques used to study the NMR of the hydrogen isotopes (H-1, D-2, T-3) as well as transition metals are discussed. Advantages of the techniques described include: (1) single crystals are not required; (2) samples need not be single phase; and (3) measurements can be made over a wide range of temperatures. J.M.S.

N81-16868# California Univ., Livermore. Lawrence Livermore Lab.
WAVEPACKET THEORY OF COLLISIONAL DISSOCIATION IN MOLECULES
Kenneth Kulander 1980 11 p refs Presented at 9th Intern. Conf. on the Few Body Probl., Eugene, Oreg., 17-23 Aug. 1980
(Contract W-7405-eng-48)
(UCRL-84785; CONF-800829-2) Avail: NTIS HC A02/MF A01

An explicit integration scheme is used to solve the time dependent Schroedinger equation for wavepackets which model collisions in the collinear H + H2 system. A realistic LEPS-type potential energy surface is used. Collision energies considered are above the dissociation threshold and probabilities for collision induced dissociation are reported and quantum mechanical state-to-state transition probabilities are generated. These results are compared to extensive classical trajectory calculations performed on this same system. The time evolution of the wavepacket densities are studied to understand the dynamics of the collinear collisional dissociation process. Author

N81-16869# Sandia Labs., Albuquerque, N. Mex.
MICROSCOPIC STUDY OF METAL HYDRIDES USING ELECTRON SPIN RESONANCE
E. L. Venturini 1980 6 p refs Sponsored by DOE
(SAND-80-1283C; CONF-801124-24) Avail: NTIS HC A02/MF A01

Electron spin resonance (ESR) of dilute paramagnetic ions in nonmagnetic metallic hydrides provides microscopic information about the hydrogen ions in the immediate vicinity of the impurity. By comparing ESR spectra for different host metals and several hydrogen/metal ratios, one can determine material properties including host lattice symmetry, phase boundaries and occupation of available sites by hydrogen. Examples are presented of ESR of dilute Er in group 3B and 4B metal hydrides, demonstrating the sensitivity and versatility of ESR as a spectroscopic technique. Author

N81-16870# Stanford Linear Accelerator Center, Calif.
PHOTON-PHOTON INTERACTIONS
Frederick J. Gilman Aug. 1980 4 p refs Presented at 9th Intern. Conf. on the Few Body Probl., Eugene, Oreg., 17-23 Aug. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2597; CONF-800829-9) Avail: NTIS HC A02/MF A01

A brief summary of the status of photon-photon interactions is presented. Stress is placed on the use of two photon collisions to test ideas on the quark constituents of hadrons and on the theory of strong interactions. M.G.

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N81-16871 North Carolina State Univ. at Raleigh.
INTENSE RELATIVISTIC ELECTRON BEAM PROPAGATION IN EVACUATED DIELECTRIC GUIDES Ph.D. Thesis
Dean Eugene Pershing 1980 138 p
Avail: Univ. Microfilms Order No. 8100812

The propagation of intense relativistic electron beams in evacuated dielectric guides without external confining fields is experimentally studied. The propagation mechanism is dependent on a beam guide interaction, wherein charge neuralization necessary for propagation is supplied by ions released from the plasma at the guide surface. The basic parameters measured were the current and energy transmission efficiencies, the beam front velocity, and the beam radial current density profile. It was observed that: (1) both current and total pulse energy are lost linearly with increasing guide length; (2) transmission efficiency increases with increasing guide diameter and is relatively insensitive to guide composition; (3) the beam front velocity is constant over the guide lengths tested and is independent of guide diameter; (4) an equilibrium beam radius is established; and (5) the transmitted current pulse rise time is significantly shortened relative to that of the diode current pulse. A qualitative model of propagation in evaculated dielectric guides is developed. Dissert. Abstr.

N81-16872# Naval Research Lab., Washington, D. C. Plasma Technology Branch.
BEAM REQUIREMENTS FOR LIGHT-ION-DRIVEN INERTIAL-CONFINEMENT FUSION Final Report
D. Mosher, D. G. Colombant, and Shyke A. Goldstein 27 Nov. 1980 21 p refs
(AD-A092472; NRL-MR-4397) Avail: NTIS HC A02/MF A01 CSCL 18/1

Pulsed-power and ion-beam production and handling techniques are available to assemble a break-even Inertial-Confinement-Fusion (ICF) experiment. In this report, simple scaling laws for beam focusing, transport, bunching and packing are combined to define an acceptable range of parameters for ignition-system modules delivering low atomic number (less than or approximately equal to 6) ion beams to a pellet. Techniques for increasing the deliverable beam intensity are then discussed. GRA

N81-16873# Naval Research Lab., Washington, D. C.
NRL INERTIAL CONFINEMENT FUSION THEORY PROGRAM, 1979 Annual Report, Oct. 1978 - Dec. 1979
20 Nov. 1980 75 p refs
(AD-A092470; NRL-MR-4369) Avail: NTIS HC A04/MF A01 CSCL 18/1

Research in each of the four current program areas is reported: Section A. Laser Light Absorption. Section B. Fluid Dynamics of Ablative Acceleration. Section C. Development of Computational Techniques. Section D. Rayleigh-Taylor Stabilization Techniques. Our work in Section A includes an analysis of anomalous absorption, backscatter and flux limitation in laser-produced plasmas. The physical processes included in the model are inverse bremsstrahlung, resonant absorption, absorption by ion-acoustic fluctuations, and Brillouin backscatter. In Section B we report our work on the energy conversion of light ion beams through the ablative acceleration of thin foils, our work on spherical shock implosion dynamics and stability, and our 1D and 2D work on the dynamics of laser-driven thin plastic foils. In Section C we report our current developments in triangular grid techniques. These results include improved calculations of the Rayleigh-Taylor instability through higher resolution in the SPLISH numerical model. In Section D, we report our improved understanding of the 'quasi-static' equilibria. We also report on our development of a vorticity generation model to study the Rayleigh-Taylor instability and include our results for test problem and actual laser-driven ablation layer profiles. We also include our work on the Rayleigh-Taylor eigenvalue problem. GRA

N81-16874# Naval Research Lab., Washington, D. C.
NRL LIGHT ION BEAM RESEACH FOR INERTIAL CONFINEMENT FUSION
G. Cooperstein, S. A. Goldstein, D. Mosher, R. J. Barker, J. R. Boller, D. G. Colombant, A. Drobot, R. A. Meger, W. F. Oliphant, and P. F. Ottinger 20 Nov. 1980 39 p refs
(Contract DE-A108-79DP-40092)
(AD-A092471; NRL-MR-4387) Avail: NTIS HC A03/MF A01 CSCL 18/1

There is presently great interest in using light ions beams to drive thermonuclear pellets. Terrawatt-level ion beams have been efficiently produced using conventional pulsed power generators at Sandia Laboratory with magnetically-insulated ion diodes and at the Naval Research Laboratory with pinch-reflex ion diodes. Both laboratories have recently focused ion beams

to pellet dimensions. This paper reviews recent advances made at NRL in the area of ion production with pinch-reflex diodes, and in the areas of beam focusing and transport. In addition, modulator generator and beam requirements for pellet ignition systems are reviewed and compared with the latest experimental results. These results include the following: (1) production of = or - 100,100 kj proton and deuteron beams with peak ion powers approaching 2 TW on the PITHON generator in collaboration with Physics International Co., (2) focusing of 0.5 TW deuteron beams produced on the NRL Gamble 2 generator to current densities of about 300 kA/sq cm, and (3) efficient transport of 100 kA level ion beams over 1 meter distances using Z-discharge plasma channels. GRA

N81-16875# Tohoku Univ., Sendai (Japan).
CURRENT AND TARGET JETS PRODUCED IN HIGH ENERGY NEUTRINO-DEUTERIUM INTERACTIONS
T. Kiragaki, S. Tanaka, H. Yuta, K. Abe, K. Hasegawa, A. Yamaguchi, K. Tamai, T. Hayashino, S. Kunori, and Y. Ohtani 1980 18 p refs Presented at the 20th Intern. Conf. on High Energy Phys., Madison, Wisc., 17-23 Jul. 1980 Prepared in cooperation with Illinois Inst. of Technology, Maryland Univ., College Park; State Univ. of New York at Stony Brook and Tufts Univ., Medford Mass. Supported in part by DOE and NSF
(CONF-800724-52) Avail: NTIS HC A02/MF A01

An analysis of approximately 7,000 charged current neutrino deuterium interactions from an exposure of a 15 foot bubble chamber to a wide band neutrino beam is discussed. It is observed that the single quark jet (current fragments) has a wider spread in transverse momentum than that from the recoiling disquark jet (target fragments) for hadronic energies > 9 GeV. This suggests an effect of gluon emission from the single quark. M.G.

N81-16876# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
THE ACCELERATION OF POLARIZED PROTONS IN CIRCULAR ACCELERATORS
E. D. Courant and R. D. Ruth 12 Sep. 1980 32 p refs
(BNL-51270) Avail: NTIS HC A03/MF A01

The theory of depolarization in circular accelerators is presented. The spin equation is first expressed in terms of the particle orbit and then converted to the equivalent spinor equation. The spinor equation is solved for three different situations: (1) a beam on a flat top near a resonance; (2) uniform acceleration through a isolated resonance; and (3) a model of a fast resonance jump. Finally, the depolarization coefficient is calculated in terms of properties of the particle orbit and the results are to a calculation of depolarization in the AGS computer program. M.G.

N81-16877# Los Alamos Scientific Lab., N. Mex.
A HIGH-CURRENT FOUR-BEAM XENON ION SOURCE FOR HEAVY-ION FUSION
R. Murray and Robert W. Hamm 1980 11 p refs Presented at 6th Conf. on the Appl. of Accelerators in Res. and Ind., Denton, Tex., 3-5 Nov. 1980
(Contract W-7405-eng-36)
(LA-UR-80-3297; CONF-801111-29) Avail: NTIS HC A02/MF A01

The growing interest in inertial confinement fusion using heavy ions elicited a proposal to use a multi-channel radio frequency quadrupole (RFQ) structure for the initial stage of the heavy ion accelerator. Based on experiments with xenon beam production with a high current duoPIGatron source, a 245 keV 4 beam xenon injector was designed for a 4 channel REQ. The injector is of modular design with 4 small independent plasma sources mounted in a 10 cm square array on a common combined extraction and acceleration column. The electrodes have 4 separate sets of apertures and each channel produces a 29 mA beam for injection into its corresponding RFQ channel. A conceptual design for the injector, code calculations for the column electrode design and results of a preliminary test carried out to verify the feasibility of the concept are presented. T.M.

N81-16878# California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
HIGH PERFORMANCE/LOW COST ACCELERATOR CONTROL SYSTEM
S. Magyary, J. Glatz, H. Lancaster, F. Selph, M. Fahmie, A. Ritchie, C. Timossi, C. Hinkson, and R. Benjegerdes Oct. 1980 6 p Presented at the 6th IEEE Conf. on the Appl. of Accelerators in Res. and Ind., Denton, Tex., 3-5 Nov. 1980
(Contract W-7405-eng-48)
(LBL-11761; CONF-801111-11) Avail: NTIS HC A02/MF A01

Implementation of a high performance computer control system tailored to the requirements of the Super HILAC accelerator is described. This system uses a distributed structure with fiber optic data links; multiple CPUs operate in parallel at each node. A large number of the latest 16 bit microcomputer boards are used to get a significant processor bandwidth. Dynamically assigned and labeled knobs together with touch screens allow a flexible and efficient operator interface. An X-Y vector graphics system allows display and labeling of real time signals as well as general plotting functions. Both the accelerator parameters and the graphics system can be driven from BASIC interactive programs in addition to the precanned user routines. J.M.S.

N81-16879# California Univ., Livermore. Lawrence Livermore Lab.
NUCLEAR WASTE MANAGEMENT: STORAGE AND DISPOSAL ASPECTS
B. D. Patterson, S. S. Dave (Power Authority of State of New York), and W. J. OConnell Sep. 1980 15 p refs Presented at Specialty Conf., Civil Eng. and Nucl. Power, Knoxville, Tenn., 15-17 Sep. 1980; sponsored by ASCE and Tennessee Univ. Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84918; CONF-800904-2) Avail: NTIS HC A02/MF A01

Long term disposal of nuclear wastes must resolve difficulties arising chiefly from the potential for contamination of the environment and the risk of misuse. Alternatives available for storage and disposal of wastes are examined. Guidelines and criteria which may govern in the development of methods of disposal are discussed. E.D.K.

N81-16880# Stanford Linear Accelerator Center, Calif.
A MODULAR SAFETY INTERLOCK SYSTEM FOR HIGH ENERGY PHYSICS EXPERIMENTS
J. Kieffer and B. V. Golceff Oct. 1980 4 p refs Presented at 1980 Nucl. Sci. and Nucl. Power Systems Symp., Orlando, Fla., 5-7 Nov. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2627) Avail: NTIS HC A02/MF A01

A frequent problem in electronics systems for high energy physics experiments is to provide protection for personnel and equipment. Interlock systems are typically designed as an afterthought and as a result, the working environment around complex experiments with many independent high voltages or hazardous gas subsystems, and modular hardware were designed make possible a standardized, integrated, hierarchical system's approach and which can be easily tailored to custom requirements. T.M.

N81-16881# Allied-General Nuclear Services, Barnwell, S.C.
AFR SPENT FUEL STORAGE PROGRAM Technical Progress Report, Jul. - Sep. 1980
24 Oct. 1980 17 p
(Contract DE-AC09-79ET-47921)
(AGNS-47921-TPR-5) Avail: NTIS HC A02/MF A01

Facility modifications for an Away-From-Reactor storage site are presented. Special focus is on the development of high density fuel storage racks. The security system for the facility is reviewed. The Barnwell Nuclear Fuel Plant was used as a model. T.M.

74 OPTICS

Includes light phenomena.

N81-16882*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RHOMBOID PRISM PAIR FOR ROTATING THE PLANE OF PARALLEL LIGHT BEAMS Patent Application

Kenneth L. Orloff and Haruo Yanagita, inventors (to NASA) (ARO, Inc., Tullahoma, Tenn.) Filed 24 Dec. 1980 10 p
(NASA-Case-ARC-11311-1; US-Patent-Appl-SN-219640) Avail: NTIS HC A02/MF A01 CSCL 20E

An optical system for rotating the plane defined by a pair of parallel light beams is described. In one embodiment, a single pair of rhomboid prisms has respective input faces disposed to receive respective input beams. Each prism is rotated about an axis of revolution coaxial with each of the respective input beams by means of a suitable motor and gear arrangement. This causes the plane of the parallel output beams to be rotated relative to the plane of the input beams. In a second embodiment, two pairs of rhomboid 15 prisms are provided. In a first angular orientation of the output beams, two prisms merely serve to decrease the lateral displacement of the output beams in order keep the beams in the same plane as the input beams. In a second angular orientation of the prisms, the input faces of the second pair of prisms are brought into coincidence with the input beams for rotating the plane of the output beams by a substantial angle such as 90 deg. NASA

N81-16883# Hughes Aircraft Co., Culver City, Calif.
TECHNIQUES FOR FABRICATING HIGH RESOLUTION LIQUID CRYSTAL RETICLES Final Technical Report, Oct. 1978 - Nov. 1980
W. Stokes and J. L. Thompson Nov. 1980 61 p refs
(Contract DAAK10-78-C-0386)
(AD-A092616; HAC-FR-80-72-1252; HAC-REF-E1635) Avail: NTIS HC A04/MF A01 CSCL 20/6

Techniques were developed to produce 98% working electrode lines without repair on LCR with a density of 580 lines per inch. Results were verified by optical inspection and electrical tests. A dual coating of silicon nitride and parylene demonstrated moisture protection, but the process was costly to apply and difficult repair. Conventional hybrid solder sealing technology was used to devise two alternate packaging concepts to maximize producibility and maintainability with potentially lower production costs. T.M.

N81-16884# Naval Postgraduate School, Monterey, Calif.
MEASUREMENT OF PERFORMANCE PARAMETERS FOR A FLIR THERMAL IMAGING SYSTEM M.S. Thesis
William Lester Sellers Jun. 1980 45 p refs
(AD-A092140) Avail: NTIS HC A03/MF A01 CSCL 17/5

The performance parameters of Noise Equivalent Temperature Difference (NETD), Minimum Resolvable Temperature Difference (MRTD), and Minimum Detectable Temperature Difference (MDTD) for the Naval Postgraduate School FLIR thermal imaging system were measured. The effects on these parameters of varying the detector aperture size (pinhole) were studied. It was determined that the thermal sensitivity of the system was directly proportional to the pinhole radius and resolution of the system was inversely proportional to the pinhole radius. Minimum values obtained were: NETD = 3.08 C, MRTD = 18 C, MDTD = 16 C. GRA

N81-16885# Scientific Research Center, Santa Monica, Calif.
THEORETICAL STUDIES OF LOW-LOSS OPTICAL FIBERS Final Report, 28 Sep. 1979 - 15 Sep. 1980
M. Sparks, W. Fredericks, D. Mills, and R. Warren 15 Sep. 1980 217 p refs
(Contract N00173-79-C-0361)
(AD-A092264) Avail: NTIS HC A10/MF A01 CSCL 20/6

Extrinsic scattering coefficients (with values as great as 1 to 100 dB/m for any one of seven scattering processes) and extrinsic absorption coefficients beta sub ab (with impurity concentrations of either isolated impurity ions or molecules, or macroscopic inclusions as low as 0.001 to 0.0001 parts per billion giving beta sub ab - 0.01 dB/km) must be greatly reduced in order to attain an extinction coefficient beta sub ex - 0.01 dB/km - 2 x 10 to the minus 8th power/cm, which is extremely low, but is a fairly modest goal for low-loss fibers. There are only a few candidate glasses, and current fabrication techniques of crystalline fibers give extinction as great as five orders of magnitude greater than 0.01 dB/km. Attaining, maintaining, and even measuring the high purity in both crystals and glasses is expected to be difficult. Impurity-absorption spectra and peak-absorption wavelengths of both infrared and visible/ultraviolet absorption are tabulated for use in identifying troublesome impurities. Experimental absorption coefficients in the infrared region are tabulated to establish the state of the art. Single-crystal alkali halides may be rendered useless as low-loss fiber materials by surface imperfections (steps) and fracture, both induced by bending. Plots in intrinsic-scattering and absorption-coefficients, the so called V curves are useful in establishing the wavelength region in which intrinsic loss is negligible. GRA

N81-16886# Arinc Research Corp., Annapolis, Md.
INFRARED MEASUREMENT VARIABILITY ANALYSIS Final Report, Oct. 1978 - Oct. 1979
N. K. Matthis, T. J. Morin, and W. E. Thompson Sep. 1980 77 p
(Contract N00173-78-C-0203)
(AD-A092068; JTCG/AS-79-C-003) Avail: NTIS HC A05/MF A01 CSCL 17/5

Two different Michelson interferometer measurement systems were used to collect spectral radiant intensity data describing blackbody emissions. These data were subjected to statistical and numerical analysis for the purpose of characterizing infrared measurement variability. A mathematical model has been postulated to describe the variability of infrared measurements based on the results of this analysis. Recommendations are made for future study to verify and extend the results presented in this report. GRA

N81-16887# McDonnell-Douglas Research Labs., St. Louis, Mo.
FAR INFRARED MERCURY-CADMIUM-TELLURIDE PHOTOCONDUCTIVE DETECTORS Final Report, 1 Jul. 1978 - 30 Jun. 1980
C. J. Summers and J. G. Broerman 1 Sep. 1980 16 p refs
(Contract F49620-78-C-0072; AF Proj. 2306)
(AD-A092073; AFOSR-80-1149TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

Measurements of the excess-electron lifetime, electron concentration, electron mobility, and photoconductive spectral response were performed on HgCdTe alloys with 17 to 24% CdTe between 5 K and 300 K. The temperature dependence of the electron concentration was well fitted by the Kane band model using energy gap determinations from photoconductivity measurements and assuming donor levels with ionization energies between 0 and 7 meV. The level of sample compensation was determined from fits to the electron mobility, which was limited by impurity scattering below 80 K. The temperature dependence of the excess-electron lifetime was analyzed with a photoconductivity theory which includes intrinsic and defect recombination mechanisms and effects from the surface recombination velocity and incident background photon flux. For all sample compositions, a characteristic dependence of electron lifetime on temperature was observed. Above 100 K the lifetime decreases with temperature and is limited by intrinsic Auger recombination. Below 100 K the lifetime decreases with decreasing temperature because of Shockley-Read recombination. A large increase in the lifetime below 40 K is observed and attributed to minority carrier trapping. GRA

N81-16888# IIT Research Inst., Chicago, Ill.
FAILURE RATES FOR FIBER OPTIC ASSEMBLIES Final Technical Report, Jun. 1979 - Aug. 1980
Steven Flint Oct. 1980 111 p refs
(Contract F30602-79-C-0161; AF Proj. 2338)
(AD-A092315; RADC-TR-80-322) Avail: NTIS HC A06/MF A01 CSCL 20/6

This report presents updated reliability prediction models for those components used in fiber optic assemblies. Device types considered include light emitting diodes (LEDs), light emitting diode (LED) displays, laser diodes, phototransistors, photodiodes, optically coupled isolators, fiber optic cables and fiber optic connectors. The reliability prediction models are presented in a form compatible with the existing models of MIL-HDBK-271C. GRA

N81-16889# Naval Postgraduate School, Monterey, Calif. Optical Propagation Group.
OVERWATER OPTICAL SCINTILLATION MEASUREMENTS DURING MAGAT-1980
E. C. Crittenden, Jr., E. A. Milne, A. W. Cooper, G. W. Rodeback,

and S. H. Kalmbach Aug. 1980 18 p refs
(AD-A092127; NPS61-80-018) Avail: NTIS HC A02/MF A01 CSCL 20/6

Overwater measurements have been made of the turbulence structure constant for index of refraction, C sub n squared, by means of scintillation for comparison with predictions of C sub n squared based on meteorological measurements carried out at the same time, during the 'Monterey Aerosol Generation and Transport' (MAGAT-1980) experiment. Scintillation was chosen as the optical measurement because it gives heaviest weight to points on the optical path near the center of the path, minimizing the shoreline effects. The over-water path length was 13.3 km. The light source was a 10.6 micrometer CO2 laser. This combination of range and wavelength was adequate to avoid saturation effects. GRA

N81-16890# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ELECTROOPTICAL DEVICES Semiannual Technical Summary Report, 1 Oct. 1979 - 31 Mar. 1980
Charles E. Hurwitz 31 Mar. 1980 23 p refs
(Contract F19628-80-C-0002; AF Proj. 2306; AF Proj. 4600)
(AD-A092699; ESD-TR-80-168) Avail: NTIS HC A02/MF A01 CSCL 20/12

This report covers work carried out with support of the Department of the Air Force during the period 1 October 1979 through 31 March 1980. A part of this support was provided by the Rome Air Development Center. CW operation at temperatures up to 55 C has been achieved for GaInAsP/InP double-heterostructure (DH) lasers emitting at 1.5 micrometers, which were grown without a GaInAsP buffer layer. These devices are of interest for use as sources in fiber-optics communications systems, since the lowest transmission loss reported for fused-silica optical fibers occurs at 1.55 micrometers. Surface passivation techniques developed for InP and GaInAsP avalanche photodiodes have resulted in reductions of dark current as large as four orders of magnitude, to values as low as .0000016 A/sq cm at 0.9 V(b) where V(b) is the breakdown voltage. Devices consisting entirely of InP have been passivated with plasma-deposited Si3N4, and those with a GaInAsP layer but with the p-n junction in InP have been passivated with polyimide. Neither of these techniques successfully reduces dark currents in devices with the p-n junction in the GaInAsP, but a film of photoresist sprayed with SF6 as the propellant has given excellent results. The electrical characteristics in InP ion implanted with Sn, Ge, Si, and C have been investigated. All of these column IV elements yielded n-type conductivity and Sn, Ge, and Si showed high electrical activation; however, implanted C was found to have a net electrical activation of only about 5 percent. GRA

N81-16891# Utah Univ., Salt Lake City. Dept. of Mathematics.
RAYLEIGH-BLOCH WAVE EXPANSIONS FOR DIFFRACTION GRATINGS 2
Calvin H. Wilcox May 1980 84 p
(Contract N00014-76-C-0276)
(AD-A092532; TR-39) Avail: NTIS HC A05/MF A01 CSCL 20/6

This report is the second part of a study of Rayleigh-Bloch (R-B) wave expansions for plane diffraction gratings. The principal concepts and results of the study, including the definition and construction of the R-B waves, the formulation of the corresponding R-B wave expansion theorem and the main ideas for the proofs were given in part 1. The present part 2 contains complete proofs of the results whose proofs were omitted or only sketched in part 1. GRA

N81-16892# Utah Univ., Salt Lake City. Dept. of Mathematics.
SCATTERING THEORY FOR DIFFRACTION GRATINGS
Calvin H. Wilcox Aug. 1980 65 p refs
(Contract N00014-76-C-0276; NR Proj. 041-370)
(AD-A092615; TSR-40) Avail: NTIS HC A04/MF A01 CSCL 20/6

Scattering theory is developed for plane diffraction gratings. The author's theory of Rayleigh-Bloch wave expansions is used to construct wave operators and a scattering operator for such gratings. For gratings that admit no surface waves, transient wave fields near the gratings are shown to behave for large times like free waves and corresponding asymptotic wave functions are calculated. These results are applied to analyze the echoes from gratings of signals due to localized sources. Finally, the echoes of sources remote from the grating are estimated and shown to be completely characterized by the S-matrix and the signal waveform. GRA

N81-16893# Air Force Geophysics Lab., Hanscom AFB, Mass. Optical Physics Div.
COMPARISON OF THE EMI LONG SEA PATH TRANSMITTANCE MEASUREMENTS WITH LOWTRAN 5 CALCULATIONS Scientific Interim Report
William O. Gallery 28 May 1980 42 p refs
(AF Proj. 7670)
(AD-A092593; AFGL-TR-0177; AFGL-ERP-703) Avail: NTIS HC A03/MF A01 CSCL 20/6

A series of broadband visible and infrared transmittance measurements made by EMI Ltd. over a 20 km sea path are compared to transmittances calculated by LOWRTAN 5. The purpose of the comparison is primarily to test the validity of the Maritime aerosol model in LOWTRAN under realistic conditions, and incidentally to test the molecular extinction in several window regions. The results of this comparison are the following: (1) the Maritime aerosol model provides a good description of aerosol extinction for conditions of a moderate wind blowing over the open ocean; (2) the calculated molecular extinction in the to 12 micron region is accurate to within 7 percent in the log of the transmittance, although there is an indication the water vapor continuum absorptio coefficient may be slightly too large; (3) the calculated molecular extinction in the 4.5 to 5.0 micron region is seriously underpredicted due to the lack of a water vapor continuum in this region. GRA

N81-16894# Honeywell, Inc., Golden Valley, Minn. Ceramic Center.
MANUFACTURING METHODS AND TECHNOLOGY FOR PRODUCTION HOT FORGING OF ALKALI HALIDE LENSES Semiannual Progress Report, 7 Sep. 1979 - 7 Apr. 1980
William B. Harrison and Regis J. Betsch 30 Jun. 1980 72 p refs
(Contract DAAK70-79-C-0138)
(AD-A092617; HONEYWELL-41695; SAPR-1) Avail: NTIS HC A04/MF A01 CSCL 20/6

The forged-to-shape process has been examined and optimized. The original process demonstrated the feasibility of forging alkali halide single crystals into lenses without the use of conventional lens polishing and figuring techniques. The process had not been optimized with respect to cost or quantity production. In the first portion of this program, the process has been examined and refined. The new process is now in a form which can be readily applied to a production environment. GRA

N81-16895# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
DISCRETE ANALOG PROCESSING FOR TRACKING AND GUIDANCE CONTROL Final Report, 1 Aug. 1978 - 15 Jan. 1981
E. S. McVey, E. A. Parrish, and R. M. Inigo Nov. 1980 189 p refs
(Contract N00014-78-C-0695)
(AD-A092875; UVA/525350/EE80/104;
ONR-CR-233-092-2F) Avail: NTIS HC A09/MF A01 CSCL 09/2

Implementation of the Taylor Series Video Image Processing (TSVIP) algorithm for tracking and guidance is presented using an HP 2100 digital computer to solve the equation. Closed loop system operation was achieved using a Reticon 100 x 100 matrix photodiode camera, a microprocessor controlled A/D converter as an interference to supply signals to the computer and pan tilt servoes operating from computer generated signals to control camera position. Tentative studies of CCD implementation including experimental data are presented for eventual elimination of the digital computer. Alternate algorithm studies compare the capabilities of complementing and supplementing methods to the TSVIP. A hierarchy of algorithms is anticipated for eventual practical implementation. GRA

N81-16896# California Univ., Livermore. Lawrence Livermore Lab.
PICOSECOND X-RAY MEASUREMENTS FROM 100 eV TO 30 keV
D. T. Attwood, R. L. Kauffman, G. L. Stradling, H. L. Medecki, R. A. Lerche, L. W. Coleman, E. L. Pierce, S. W. Thomas, D. E. Campbell, J. Noonan et al 15 Oct. 1980 50 p refs Presented at 14th Intern. Congr. on High Speed Photo. and Photonics, Moscow, 19-24 Oct. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-85043; CONF-801094-1) Avail: NTIS HC A03/MF A01

Picosecond X-ray measurements relevant to the laser fusion program are reviewed. Resolved to 15 picoseconds, streak camera detection capabilities extend from 100 eV to higher than 30 keV, with synchronous capabilities in the visible, near infrared, and ultraviolet. Capabilities include automated data retrieval using charge coupled devices, absolute X-ray intensity levels, novel cathodes, X-ray mirror/reflector combinations, and a variety of X-ray imaging devices. Author

N81-16897*# New Mexico Univ., Albuquerque.
OPTICAL MEMORY SYSTEM TECHNOLOGY. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE Progress Report, 1974 - Aug. 1980
Gerald F. Zollars Sep. 1980 49 p Sponsored by DOE and NTIS
(NASA-CR-163457; PB80-815848; NTIS/PS-79/0944) Avail: NTIS HC $30.00/MF $30.00 CSCL 08I

Approximately 213 citations from the international literature which concern the development of the optical data storage system technology are presented. Topics covered include holographic computer storage devices, crystal, magneto, and electro-optics, imaging techniques, in addition to optical data processing and storage. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N81-16898# Committee on Science and Technology (U. S. House).
FUSION ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION ACT OF 1980
Washington GPO 1980 26 p Rept. to accompany H. R. 6308 presented by the Comm. on Sci. and Technol. at the 96th Congr., 2nd Sess., 17 Jun. 1980
(H-Rept-96-1096) Avail: US Capitol, House Document Room

An accelerated program for development of magnetic fusion energy leading to commercialization of the technology is described. The fusion technology will provide energy for the generation of electricity and production of heat, hydrogen and synthetic fuels. S.F.

N81-16899# Massachusetts Inst. of Tech., Cambridge.
MHD EFFECTS ON VISCOUS AND THERMAL WAKES AND THEIR INFLUENCE ON THE PERFORMANCE OF MHD GENERATORS
Steven J. Schneider (Westinghouse Research and Development Center, Pittsburgh, Pa.) and Jean F. Louis 8 Jan. 1979 38 p refs Backup Document for AIAA Synoptic Scheduled for Publication in the Journal of Aircraft, Jan./Mar. 1981
(LOG-E281) Avail: NTIS HC A03/MF A01

The development of velocity and thermal wakes induced by inlet vanes are analyzed separately and their influence on the performance of magnetohydrodynamic (MHD) generators is evaluated. The velocity wake has uniform conductivity, a magnetic field parallel to the vorticity and uniform current passed through the channel. An analytical solution is determined for the wake as a function of the MHD interaction parameter where the rising interaction parameter causes a greater velocity defect and the greater velocity defect decreases the electrical efficiency. The thermal wake has uniform velocity at any cross section of the channel, a magnetic field parallel to the vorticity and uniform current passed through the channel. An analytical solution for the conductivity wake as a function of the MHD interaction parameter is presented. This solution is exact only for the case of maximum power delivered to the load but is also accurate for a channel with loading factor less than 0.7. Increasing the interaction parameter decreases the thermal defect and the decreased thermal defect increases the electrical efficiency. M.G.

N81-16900*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH POWER DENSITIES FROM HIGH-TEMPERATURE MATERIALS INTERACTIONS
James F. Morris 1981 22 p refs Presented at 16th Thermophys. Conf., High Temp. Mater. Session, Palo Alto, Calif., 23-25 Jun. 1981; sponsored by AIAA
(Contract EC-77-A-31-1062)
(NASA-TM-81626; DOE/NASA/1062-7) Avail: NTIS HC A02/MF A01 CSCL 20I

Thermionic energy converters and metallic-fluid heat pipes are well suited to serve together synergistically. The two operating cycles appear as simple and isolated as their material problems seem forebodingly deceptive and complicated. Simplified equations verify material properties and interactions as primary influences on the operational effectiveness of both. Each experiences flow limitations in thermal emission and vaporization because of temperature restrictions redounding from thermophysicochemical stability considerations. Topics discussed include: (1) successful limitation of alkali-metal corrosion; (2) protection against external hot corrosive gases; (3) coping with external and internal vaporization; (4) controlling interfacial reactions and diffusion; and (5) meeting other thermophysical challenges; expansion matches and creep. A.R.H.

N81-16901# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
STUDY OF THE ANATOMY OF THE X-RAY AND NEUTRON PRODUCTION SCALING LAWS IN THE PLASMA FOCUS Final Report, 1 Oct. 1979 - 30 Apr. 1980
V. Nardi and W. Prior 15 May 1980 20 p refs Submitted for publication
(Grant AF-AFOSR-2754-75; AF Proj. 2301)
(AD-A091991; SIT-P2002; AFOSR-80-1140TR) Avail: NTIS HC A02/MF A01 CSCL 20/9

This report investigates the correlation between the neutron (and X-ray) emission intensity and the intensity of the particle beams generated in a plasma focus discharge in deuterium as an extension of our previous work on scaling laws of X-ray and neutron production. The structure of dense plasmoids which emit MeV ions has been recorded by ion imaging with pinhole camera and contact print techniques. The plasmoids are generated in the same region in which particle beams, neutron and X-ray emission reach a maximum of intensity. Sharply defined boundaries of the ion-beam source and of plasmoids have been obtained by ion track etching on plastic material CR-39. GRA

N81-16902# STD Research Corp., Arcadia, Calif.
A COMPUTER STUDY OF HIGH MAGNETIC REYNOLDS NUMBER MHD CHANNEL FLOW Final Report, 1 Aug. 1977 - 31 Oct. 1980
D. A. Oliver, T. F. Swean, Jr., C. D. Bangerter, S. T. Demetriades, and C. D. Maxwell 1 Nov. 1980 44 p refs
(Contract N00014-77-C-0574)
(AD-A092215; STDR-80-41) Avail: NTIS HC A03/MF A01 CSCL 20/3

A summary of progress made in the prediction of magneto-gasdynamic phenomena in explosion MHD flows. Theoretical and computational results are presented for quasi-one-dimensional, two dimensional, quasi three dimensional and high Reynolds number flows in both weak and strong MHD interaction. GRA

N81-16903# Case Western Reserve Univ., Cleveland, Ohio. Plasma Research Lab.
MOMENTUM DISTRIBUTION OF IONS IN PLASMA BEAM Final Scientific Report, 1 May 1979 - 30 Apr. 1980
A. Ferendeci, O. K. Mawardi, Paul Webster, and Paul Elkman 30 Jun. 1980 17 p refs
(Contract F49620-79-C-0064; AF Proj. 2301)
(AD-A092385; AFOSR-80-1046TR) Avail: NTIS

HC A02/MF A01 CSCL 20/9

This report describes a modified time of flight analyzer that was used to measure the velocity distribution function of the ions in a dense plasma beam. The beam is produced with a coaxial gun of the Cheng type. The beam density is approximately 10 to the 17th power/cc, and the ions have an average directed velocity of 800 eV. The ions are cold while the electrons have a temperature of 40 eV. The density and energy of the ions in the beam are suitable for injection in a Shiva machine. GRA

N81-16904# Naval Research Lab., Washington, D. C.
A NEW THEORY FOR STRIATIONS WITH EXPERIMENTAL VERIFICATIONS Interim Report
E. E. Kempe 14 Oct. 1980 149 p refs
(RR0210541)
(AD-A092058; NRL-8261) Avail: NTIS HC A07/MF A01 CSCL 20/9

A new general theory for striated positive columns containing atomic or molecular fill gases is elaborated that gives a unified explanation of both standing striations and cathode-directed and anode-directed moving striations along with the significance of the Novak potential. The p, r, and s striation varieties in neon are explained according to this new theory, including the ionization mechanisms associated with their generation, and the results are experimentally verified via measurements in neon discharges and Penning discharges of neon with argon admixtures. The mathematical model of the positive column derived for this theory shows how an open-loop instability that is an inherent feature of the process maintaining the charged particle density along the column sustains self-excited striations. To illustrate the basic nature of the open-loop instability leading to self-excited striations, a simple analog of the positive column is presented. This new theory therefore contrasts with the widely accepted viewpoint of Pekarek that self-excited striations are caused by closed-loop feedback paths consisting of propagating 'ionization waves' which couple disturbances back to their point of origin with sufficient amplitudes to excite successive ionization waves. Standing striations in RF-excited columns are also explained. GRA

N81-16905# Naval Research Lab., Washington, D. C. Lab. for Computation Physics.
LINEAR STABILITY OF SELF-SIMILAR FLOW. 8: IMPLODING CYLINDRICAL AND SPHERICAL SHOCKS IN THE C-C-W APPROXIMATION Interim Report
John H. Gardner, David L. Book, and Ira B. Bernstein (Yale Univ., New Haven, Conn.) 31 Oct. 1980 39 p refs
(AD-A092588; NRL-MR-4370) Avail: NTIS HC A03/MF A01 CSCL 20/9

Analytical and computational techniques are developed to investigate the stability of converging shock waves in cylindrical and spherical geometry. The linearized Chester-Chisnell-Whitham (C-C-W) equations describing the evolution of an arbitrary perturbation about an imploding shock wave in an ideal fluid are solved exactly in the strong-shock limit for a density profile rho(r) approx (r to the -q power). All modes are found to be relatively unstable (i.e., the ratio of perturbation amplitude to shock radius diverges as the latter goes to zero), provided that q is not too large. The nonlinear C-C-W equations are solved numerically for both moderate and strong shocks. The small-amplitude limit agrees with the analytical results, but some forms of perturbation which are stable at small amplitude become unstable in the nonlinear regime. The results are related to the problem of pellet compression in experiments on inertial confinement fusion. GRA

N81-16906# Princeton Univ., N. J. Plasma Physics Lab.
ANALYTICAL STUDY OF THE EXTERNAL FIELD FOR NON-CIRCULAR TOKAMAK WITH MULTIPOLE MOMENT EXPANSION APPROACH
O. Okada (Hitachi, Ltd., Tokyo), J. Delucia, and M. Okabayashi Oct. 1980 31 p refs
(Contract DE-AC02-76CH-03073)
(PPPL-1718) Avail: NTIS HC A03/MF A01

The external field required to produce noncircular toroidal magnetohydrodynamic equilibria is studied analytically. The external magnetic flux pattern is formulated with a series of multipole moments expanded around the magnetic axis. A common description of the external field characteristics of various devices is provided than specifying location of poloidal coils. The preconceptual design of noncircular devices is simplified since the arrangement of poloidal coil location is decoupled from the physics requirement. Author

N81-16907# Princeton Univ., N. J. Plasma Physics Lab.
MHD DESCRIPTION OF PLASMA: HANDBOOK OF PLASMA PHYSICS
R. M. Kulsrud, R. N. Sagdeev, ed., and M. N. Rosenbluth, ed. Oct. 1980 66 p refs
(Contract DE-AC02-76CH-03073)
(PPPL-1705) Avail: NTIS HC A04/MF A01

The basic sets of MHD equations for the description of a plasma in various limits are derived and their usefulness and limits of validity are discussed. These limits are: the one fluid collisional plasma, the two fluid collisional plasma, the Chew-Goldberger Low formulation of the guiding center limit of a collisionless plasma and the double adiabatic limit. Conservation relations are derived from these sets and the mathematics of the concept of flux freezing is given. An example is given illustrating the differences between guiding center theory and double adiabatic theory. Author

N81-16908# Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
HYFIRE: A TOKAMAK HIGH TEMPERATURE ELECTROLYSIS SYSTEM
J. A. Fillo, J. R. Powell, M. Steinberg, R. Benenati, F. Horn, H. Isaacs, O. W. Lazareth, H. Makowitz, and J. Usher 1980 10 p refs Presented at the 3rd Miami Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 15-17 Dec. 1980 Sponsored in part by DOE
(BNL-28679; CONF-801210-9) Avail: NTIS HC A02/MF A01

The conceptual design HYFIRE, a commercial fusion Tokamak reactor, high temperature electrolysis system, is discussed with emphasis on the adaptability of the STARFIRE power reactor to a synfuel application. The HYFIRE blanket must perform three functions: (1) provide high temperature (approximately 1400 C) process steam at moderate pressures (in the range of 10 to 30 atm) to the high temperature electrolysis (HTE) units; (2) provide high temperature (approximately 700 to 800 C) heat to a thermal power cycle for generation of electricity to the HTE units; and (3) breed enough tritium to sustain the D-T fuel cycle. In addition to thermal energy for the decomposition of steam into its constituents, H2 and D2, electrical input is required. Fourteen hundred degree steam coupled with 40% power cycle efficiency results in a process efficiency (conversion of fusion energy to hydrogen chemical energy) of 50%. A.R.H.

N81-16909# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
OPERATIONAL ANALYSIS OF OPEN-CYCLE MHD Final Report
T. E. Lippert and D. A. McCutchan Jul. 1980 268 p refs
(EPRI Proj. 639-1)
(EPRI-AP-1463) Avail: NTIS HC A12/MF A01

Open cycle magnetohydrodynamic (OCMHD) conceptual power plant designs are studied in the context of a utility system to form a better basis for understanding their design, design requirements, and market possibilities. Based on assumed or projected plant costs and performance characteristics, assumed economics and escalation factors, and one coal supply and delivery scenario, overall and regional OCMHD utility market possibilities are reviewed. Additionally, for one hypothetical utility system a generation expansion plan is developed that includes OCMHD as a baseload power generating station. The impact on generation system economics and operation of alternating selected MHD plant cost and performance characteristics is reviewed. Baseload plant availability is shown as an important plant design consideration, and a general methodology and data base is developed to assess the impact on design and cost of various reliability decisions. An overall plant availability goal is set and the required availabilities of various MHD high technology components are derived to meet the plant goal. The approach is then extended to projecting channel life goals for various plant design configurations and assumptions. Author

N81-16910# Mathematical Sciences Northwest, Inc., Bellevue, Wash.

LINUS CYCLE CALCULATIONS INCLUDING PLASMA TRANSPORT AND RESISTIVE FLUX LOSS IN AN INCOMPRESSIBLE LINER

D. C. Quimby, A. L. Hoffman, and G. C. Vlases Aug. 1980 51 p refs

(Contract DE-AC06-80ER-53096)

(MSNW-80-1144-4) Avail: NTIS HC A04/MF A01

A one dimensional plasma transport and burn code, including incompressible liner dynamics with heat transfer and temperature dependent flux diffusion in the liquid metal, is used to model LINUS cycles. The effects of compressibility are treated as a perturbation. Numerical coefficients are derived for simple LINUS scaling laws. The particular case of plasma contact with the liquid metal is studied to determine the effect on LINUS performance. Some thermal contact with the liner prior to peak compression does not kill the plasma burn, and can thus be allowed in compression scenarios. However, the tendency of field to remain imbedded in the hot plasma is not sufficient to significantly retard diffusive flux loss into the liner, and thus, does not reduce the minimum LINUS size. A.R.H.

N81-16911# Sandia Labs., Albuquerque, N. Mex.

THEORETICAL MODEL FOR PLASMA OPENING SWITCH

Louis Baker Jul. 1980 51 p refs

(SAND-80-1178) Avail: NTIS HC A04/MF A01

The theory of an explosive plasma switch is developed and compared with the experimental results. A simple analytic model is developed, which predicts that such switches may achieve opening times of approximately 100 ns. When the switching time is limited by channel mixing it scales as t = C(m d sub 0)(1/2)P sub 0(2)P sub e(-5/2) where m is the foil mass per unit area, d sub 0 the channel thickness and P sub 0 the channel pressure (at explosive breakout), P sub e the explosive pressure, C a constant of order 10 for c.g.s. units. Thus faster switching times may be achieved by minimizing foil mass and channel pressure, or increasing explosive product pressure, with the scaling exponents as shown suggesting that changes in pressures would be more effective. M.G.

N81-16912# Los Alamos Scientific Lab., N. Mex.

INFLUENCE OF A VACUUM REGION ON THE STABILITY OF A HIGH-BETA SCREW PINCH

Thomas E. Cayton Oct. 1980 14 p refs

(LA-8495-MS) Avail: NTIS HC A02/MF A01

The stability properties of two confinement configurations are compared to ascertain the influence of a vacuum region on the stability of a high beta screw pinch. Both configurations involve diffuse equilibrium profiles and a rigid, perfectly conducting cylindrical shell. In the first problem, perfectly conducting plasma extends to the rigid conducting wall; the plasma is extremely tenuous in the outer region of the pinch, however. In the second case, profiles identical to those of the first problem are chosen for the central portion of the pinch, but the outer tenuous plasma is replaced by a perfectly insulating vacuum region. The two configurations are found to be unstable for the same range of external parameter values; different modes are unstable in the two cases, however. Thus, the presence of a vacuum region does not affect the stability boundary of the pinch, but it does affect the nature of the unstable modes. Author

N81-16913# Los Alamos Scientific Lab., N. Mex.

TEMPERATURE DIAGNOSTICS USING LITHIUM-LIKE SATELLITES

R. U. Datla (Maryland Univ., College Park), L. A. Jones, and D. B. Thomson Oct. 1980 15 p refs

(LA-8324-MS) Avail: NTIS HC A02/MF A01

A 60-kj theta-pinch was operated at a filling pressure of 16 mtorr using a gas mixture of 2% neon and 98% helium. The resonance and intercombination lines from Ne 9 and the Li-like satellites were observed with a Bragg crystal monochromator. The electron temperature of the plasma was deduced from the intensity ratios of the Ne 9 resonance line and the dielectronic satellites using recent theoretical calculations. The temperature values ranged from 210 eV to 340 eV during the time of occurrence of these satellites. The temperature measured at 1.0 microsecond laser scattering for a similar plasma condition was in close agreement with that obtained by the resonance line/satellite ratio. Author

N81-16914# Los Alamos Scientific Lab., N. Mex.

H-BEAM FORMATION FROM A PENNING SURFACE PLASMA SOURCE USING CIRCULAR EMISSION-EXTRACTOR ELECTRODES

Joseph D. Sherman, Paul Allison, and H. Vernon Smith, Jr. 1980 6 p refs Presented at 2nd Intern. Symp. on the Production and Neutralization of Negative Hydrogen Ions and Beams, Upton, N.Y., 6-10 Oct. 1980

(Contract W-7405-eng-36)

(LA-UR-80-2831; CONF-801068-10) Avail: NTIS HC A02/MF A01

The possibility of using circular extractor geometries to simultaneously obtain both symmetrical and low-emittance H beams from a penning surface plasma source is studied. Circular emission-extractor electrodes are used to extract H ions from a Penning surface-plasma source, with the calculated space-charge limited current being observed. Emittance measurements are extended to include emittance as a function of beam fraction. Comparatively noise-free discharge voltages led to a factor of three reduction in emittance. Equal emittances in the transverse phase spaces are observed for the circular geometries. M.G.

N81-16915# Los Alamos Scientific Lab., N. Mex.

A ROTATING PENNING SURFACE-PLASMA SOURCE FOR dc H(-) BEAMS

Vernon H. Smith 1980 4 p refs Presented at the 2nd Intern. Symp. on the Production and Neutralization of Negative Hydrogen Ions and Beams, Upton, N.Y., 6-10 Oct. 1980

(Contract W-7405-eng-36)

(LA-UR-80-2830; CONF-801068-9) Avail: NTIS HC A02/MF A01

The possibility of using a Penning surface-plasma source (SPS) with rotating electrodes to produce dc H beams is investigated. In the rotating ion source (RIS), the average power density on the electrodes is reduced by magnetically confining the discharge to a small region near the emission slit while maintaining the geometry and instantaneous power density of the fixed-electrode Penning SPS. H beam currents (2.5 mA at 100% duty factor, 104 mA at 1.5% duty factor) and two dimensional normalized emittances (0036 pi cmmrad x 0.009 pc cm mrad for 40% of a 1.5mA, dc H-beams similar to those of the fixed-electrode Penning SPS are produced by the uncooled RIS reported. The scaling to a 100% duty factor, fully cooled RIS is briefly discussed. M.G.

N81-16916# California Univ., Livermore. Lawrence Livermore Lab.

TECHNOLOGY FOR LARGE TANDEM MIRROR EXPERIMENTS

Keith I. Thomassen 4 Sep. 1980 7 p refs Presented at 11th Symp. on Fusion Technol., Oxford, 15-19 Sep. 1980

(Contract W-7405-eng-48)

(UCRL-84278; CONF-800950-4) Avail: NTIS HC A02/MF A01

Construction of a large tandem mirror designed to reach break-even plasma conditions is described. A single cell minimum -B mirror fusion test facility is undergoing reconfiguration for this purose. A.R.H.

N81-16917# California Univ., Livermore. Lawrence Livermore Lab.

THE SUSTAINING NEUTRAL BEAM POWER SUPPLY SYSTEM

Royce D. Eckard, John H. Wilson, and Hubert W. VanNess 1980 9 p refs Presented at the 11th Symp. on Fusion Technol., Oxford, 15-19 Sep. 1980

(Contract W-7405-eng-48)

(UCRL-84312; CONF-800950-5) Avail: NTIS HC A02/MF A01

The fabrication of the first two power supply sets is progressing. The engineering tests were completed on the Suppressor, filament and arc power supplies and low voltage tests were successfully completed on the ADCPS. The ADCPS rectifier transformer at the passed all the short circuit tests with less than 0.4 percent change in the transformer impedance.

Non-synchronous closing of the arc power supply contactor onto the ac power line caused two problems: a transient that had a ringing frequency of 700 Hz caused excessive power dissapation on the input voltage transient suppressors, and secondly, transformer saturation occurred on some pulses causing excessive ripple during the first 300 milliseconds of the pulse. A possible solution being evaluated, is to close and open the ac contactor at nearly the same phase of the ac sine wave each time of operation. Aside from the above two problems the arc power supply has met the intended specification when operated into both a dummy load and an actual sustaining neutral beam arc chamber. A.R.H.

N81-16918# Oak Ridge National Lab., Tenn. Fusion Energy Div.
CHARGE EXCHANGE MEASUREMENTS OF ION BEHAVIOR IN THE ISX TOKAMAK
George Hutchinson Neilson, Jr. Dec. 1980 164 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7333) Avail: NTIS HC A08/MF A01

The analysis of charge exchange neutrals as a method for measuring ion behavior in Tokamak plasmas is addressed. Limitations of this technique, which arise in dense and neutral beam heated plasmas, are discussed. Two refinements that address these limitations are described: a neutral particle analyzer, which incorporates both mass and energy resolution to distinguish different ion components such as the fast and thermal ions in beam heated plasmas, and data analysis procedure, which accounts for the effects of profiles and neutral attenuation in dense plasmas. A simple two dimensional Monte Carlo neutral transport code was developed and used to investigate the effects of toroidally asymmetric neutral density profiles. Applications of these methods to experiments in the impurity study experiment (ISX) are discussed; they include energy confinement studies on ISX-A, neutral beam heating and high beta studies on ISX-B, and pellet fueling studies on ISX-B. M.G.

N81-16919# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
CT-TRX1, A TRIGGERED-RECONNECTION COMPACT TOROID EXPERIMENT
A. L. Hoffman May 1980 44 p refs Sponsored by DOE
(MSNW-80-1144-3) Avail: NTIS HC A03/MF A01

A new compact toroid experiment, CT-TRX1, based on the field reversed theta pinch incorporates several quasisteady and pulsed magnets to carefully control the reconnection process. The motivation for this emphasis is to duplicate and extend the results reported by Kurtmullaev, et al., where delayed reconnection produced efficient axial shock heating and resulted in large diameter compact toroids which exhibited complete MHD stability for the 100 micron usec decay time of their pulsed magnets. CT-TRX1 incorporates moderate E sub theta radial shock heating, along with the triggered reconnection capability, to investigate the full range of conditions between the USSR experiments and the radial shock heated experiments at LASL, where m = 2 rotational instabilities occur. An additional feature of CT-TRX1 is the incorporation of a compound magnet which will provide long magnetic field decay time. The requirements for both high field quasisteady outer magnets, and several high voltage, individually triggered pulsed inner magnets, presents unique engineering design problems which are discussed. A.R.H.

N81-16920 California Univ., Berkeley.
HAMILTONIAN THEORY OF GUIDING CENTER MOTION Ph.D. Thesis
Robert Grayson Littejohn 1980 229 p
Avail: Univ. Microfilms Order No. 8029478

A theory of guiding center motion which uses noncanonical coordinates in phase space and rectangular coordinates in physical space is discussed. Methods are developed for carrying out Hamiltonian perturbation theory in noncanonical coordinates and these preserve all the computational advantages of the more traditional Hamiltonian methods. Close attention is paid to the Poisson brackets of the coordinates among themselves. Darboux's theorem is used to create a set of coordinates which satisfy certain Poisson bracket relations and which simultaneously have a dynamical significance in the perturbation expansion. Lie transforms are used to carry out the perturbation expansion itself. The theory is applied to the motion of a nonrelativistic particle moving in a magnetostatic field. The guiding center variables are represented as formal power series in the adiabatic parameter epsilon of functions of the particle's position x and velocity v. Successive applications of the underlying transformation theory produce a Hamiltonian formulation of guiding center bounce and drift motions. Averaged equations of motion are derived as well as the series for the adiabatic invariants through (epsilon). Dissert. Abstr.

N81-16921 California Univ., Berkeley.
EVALUATION OF TWO-BEAM SPECTROSCOPY AS A PLASMA DIAGNOSTIC Ph.D. Thesis
Barton Dawes Billard 1980 208 p
Avail: Univ. Microfilms Order No. 8029332

A two beam spectroscopy system is evaluated theoretically and experimentally. This spectroscopic technique uses correlations between components of emitted light separated by a small difference in angle of propagation. It is a nonperturbing plasma diagnostic which is shown to provide local (as opposed to line of sight averaged) information about fluctuations in the density of light sources within a plasma information not obtainable by the usual spectroscopic methods. The improved design, which abandons some of the components previously deemed essential, does not sacrifice any of the capabilities of the earlier systems in exchange for greater simplicity and increased light efficiency. The hot cathode discharge and prototype TBS system built for evaluation of the technique are described. Dissert. Abstr.

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N81-16922 Lehigh Univ., Bethlehem, Pa.
CHARGE TRAPPING AND ASSOCIATED LUMINESCENCE IN MOS OXIDE LAYERS Ph.D. Thesis
Ciro Falcony-Guajardo 1980 188 p
Avail: Univ. Microfilms Order No. 8102499

Charge trapping and associated luminescence phenomena in thermally grown silicon dioxide films incorporated in metal-oxide-semiconductor (MOS) structures are studied. A pulsed current avalanche injection of electrons was used. The magnitudes of both oxide trapped charge and luminescence intensity were simultaneously measured as a function of injection time under constant average electron current conditions. These phenomena were studied as a function of selected processing variations for the thermal SiO2 films and/or MOS devices. The spectral distributions of the luminescence emission from several trapping centers were studied. A constant luminescence emission was observed throughout the avalanche injection process. This light emission is probably generated in the deep depletion region formed in the Si substrate at the time of avalanche injection. After long times of avalanche injection, a turn around of the flat band shifts was observed, corresponding to a positive charge buildup at the Si-SiO interface. An associated enhancement of the luminescence was found to be proportional to the positive charge accumulated at the interface. Dissert. Abstr.

N81-16923 Louisville Univ., Ky.
A MOSSBAUER EFFECT STUDY OF THE FERROELECTRIC TRANSITION IN BaTiO3 Ph.D. Thesis
Thankappan Atchuthan Kutty Pillai 1980 95 p
Avail: Univ. Microfilms Order No. 8028986

The nature of the ferroelectric transition in BaTiO3 is investigated in relation to the proposed soft mode behavior. Experimental evidence was sought for the softening of the transverse optical mode responsible for ferroelectricity in such crystals. From the results of the series of experiments conducted, it is inferred that a ferroelectric like BaTiO3 does not have the limiting behavior of either a purely displacive or an order disorder type transition; but it shows considerable order disorder nature at the displacive limit (transition point). Further, it is verified that the strong internal electric field at the Ti4+ site in

BaTiO3 tends to polarize the electron shells of the substituted Mossbauer probe. Dissert. Abstr.

N81-16924 Ohio State Univ., Columbus.
THE EFFECT OF A METAL FILM ON THE SURFACE BOUNDARY CONDITIONS OF VITRIUM IRON GARNET THIN FILMS Ph.D. Thesis
Barbara Ann Dean 1980 152 p
Avail: Univ. Microfilms Order No. 8100139

The effect of the introduction of various magnetic and electronic interactions at the free surface of a thin film of yttrium iron garnet (YIG) on the magnetic boundary conditions was investigated using ferromagnetic resonances. The alterations at the surface were produced by a surface reduction of the garnet by aluminum, and by evaporation of metallic chromium and vanadium onto the film. The isotropic and uniaxial contributions to the surface anisotropy for these samples and for a control were calculated using the positions of the spin wave modes. The reduction of the garnet by Al resulted in a region about 0.2 microns thick with an increased concentration of Fe2- ions relative to the bulk. The temperature dependence of the surface mode seen in parallel resonance was accounted for by the behavior of the magnetostriction and crystalline anisotropy due to Fe2. The effect of Cr on the free surface of YIG was to introduce a magnetic interaction which produced a surface mode in perpendicular resonance. In the V/YIG samples the temperature dependence closely followed that of the control, but below 50 K, the surface mode was both more localized and more intense. It was suggested that this surface mode was due to the presence of Fe4+ ions on the surface. Dissert. Abstr.

N81-16925 Texas A&M Univ., College Station.
A STUDY OF THE PROXIMITY EFFECT IN AMORPHOUS SUPERCONDUCTING FILMS Ph.D. Thesis
Gary Paul Cort 1980 81 p
Avail: Univ. Microfilms Order No. 8101585

Transition temperature measurements were performed on amorphous films of bismuth and tin with iron overlayer. From these measurements, values of the superconducting coherence length xi sub s and De Gennes extrapolation length b are determined with an analysis technique. The controversy regarding conflicting values of xi sub s reported in the literature is resolved through a careful analysis of the measurement uncertainties inherent in proximity effect experiments. An improved method for masking the substrates on which the films are grown is reported which significantly reduces these errors. Results show excellent agreement with the theoretical predictions. In addition, values of xi sub s agree well with independent measurements reported in the literature. The pair penetration depth is found to be comparable to values determined from other proximity effect experiments using iron ferromagnetic overlayers. Dissert. Abstr.

N81-16926 Texas Univ. at Austin.
SURFACE AND INTERFACE ELECTRONIC STRUCTURE OF TRANSITION METALS Ph.D. Thesis
William Robert Grise, Jr. 1980 179 p
Avail: Univ. Microfilms Order No. 8100909

Calculations of the energy bands and electronic densities of states of 35 atomic layer (100), 47 atomic layer (110), and 32 atomic layer (111) nickel (ferromagnetic) thin films are performed using the method of tight binding. Four zeroth neighbor, and ten each of first, second, and third neighbor Hamiltonian and overlap parameters are obtained by fitting the bulk nickel bands calculated at 43 points in the 1/48 irreducible Brillouin zone. With these parameters, the two dimensional bands and densities of states for all three faces of nickel are calculated. Evidence is given for a one electron explanation via surface states in the (100) face of the anomalous spin photoelectron polarization. Using the identical parameterization scheme, the energy bands for a 39 layer tungsten thin film, with and without spin orbit coupling, are calculated and compared. Two of three surface features observed in tungsten (001) photoemission are found, as well as spin orbit induced surface states at high symmetry points in the two dimensional Brillouin zone. Finally, the electronic structure of a nickel crystal containing periodically repeated stacking faults of the three principal kinds are explored.
Dissert. Abstr.

N81-16927 North Texas State Univ., Denton.
THE SIZE EFFECT ON THE GALVANOMAGNETIC PROPERTIES OF A SEMICONDUCTOR Ph.D. Thesis
Vernon Devon Smith 1980 177 p
Avail: Univ. Microfilms Order No. 8100092

A theory is developed to explain the dependence of carrier transport in a thin semiconducting film on film thickness, magnetic field strength, and the dominant bulk scattering mechanism. This theory is based on the solution of the linearized Boltzmann equation in relaxation time form. The semiconductor is assumed to be bounded and nondegenerate with spherical energy surfaces and a scalar effective mass. It is also assumed to be flat banded with totally diffuse scattering at the surface. Classical Boltzmann statistics are used for equilibrium. The dependence of the relaxation time on the carrier energy is approximated by a power law equations. Dissert. Abstr.

N81-16928 California Univ., Berkeley.
MICROSTRUCTURE DEVELOPMENT AND INTERFACE STUDIES IN THICK FILM CONDUCTOR SYSTEMS Ph.D. Thesis
V. K. Nagesh 1980 144 p
Avail: Univ. Microfilms Order No. 8029517

A thick film conductor system which used acid treated (.01N HCl) lead borosilicate glass particles with chemically coated metal (silver) film was developed. Using only 40 wt percent metal (silver), sheet resistivities as low as 45 milliohms/sq were obtained. Microstructure was studied. Effect on the acid treatment of the glass particles prior to the metal coating was analyzed. X-ray photoelectron spectra studies showed preferential leaching of lead and boron from the surface of the glass. Good bonding between silver film and the glass was attributed to the oxidation of silver in the presence of oxygen and H+ ions on the glass surface (from acid treatment) and subsequent diffusion of Ag+ into the glass to form a continuous chemical interface. A model to predict sheet resistivities of the new thick film conductors was developed. Dissert. Abstr.

N81-16929# Spire Corp., Bedford, Mass.
HGCDTE FABRICATION USING DIRECTED ENERGY TECHNIQUES Semiannual Technical Report, 1 Mar. - 31 Aug. 1980
Anton C. Greenwald and Robert G. Wolfson Sep. 1980 49 p refs
(Contract MDA903-79-C-0434; ARPA Order 3800)
(AD-A091983; SAR-80-10071-02) Avail: NTIS HC A03/MF A01 CSCL 20/12

The goal of this research program is to develop hot-wall vacuum deposition and new epitaxy techniques capable of producing HgCdTe semiconductor alloys for future mosaic focal plane applications. The approach is to deposit a large (50 mm o.d.), thin film of CdTe, change its structure to that of a single crystal by either heteroepitaxy or graphoepitaxy, and then modify its composition to Hg sub x Cd sub (1-x) Te by either vapor exchange or ion implantation and annealing. Pulsed electron beam processing will be tested for both heteroepitaxial and graphoepitaxial growth of a thin crystalline film, and for pulse annealing high-dose implants in CdTe. This new technology should result in larger, more uniform crystals of HgCdTe than are currently available (and unsuitable) for the proposed application. Results to date have demonstrated that single-crystal CdTe films up to 17 micrometers thick can be deposited on mica, and that CdTe and HgCdTe can be pulse processed without damaging the surface. Initial nonstoichiometric evaporations have been corrected. GRA

N81-16930# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Hochfrequenztechnik.
NEW PASSIVATION METHODS OF GaAs Final Report, 1 Oct. 1978 - 31 Jan. 198
H. Adachi, H. L. Hartnagel, S. Hannah, E. Huber, and D. Pavlidis Jan. 1980 167 p refs
(Grant DA-ERO-78-G-103)
(AD-A092354) Avail: NTIS HC A08/MF A01 CSCL 20/12

With the information provided by previous ESCA studies that there is non-oxidized as in the oxide near the interface, detailed efforts have been undertaken to produce MOS structures without this deficiency. A two step insulator fabrication scheme

was used to obtain improved capacitance-voltage characteristics. Other efforts concerned the deposition for different insulators on GaAs. The passivation of quarternary compound semiconductors was undertaken. Results on the experimental investigation regarding the mechanism of light emission from thin MOS structures are reported. GRA

N81-16931# Tel-Aviv Univ. (Israel). Dept. of Interdisciplinary Studies.
INTERDIFFUSION OF METALS AND SEMICONDUCTORS Final Research Report, 1 May 1979 - 30 Apr. 1980
Y. Shapira 30 Jun. 1980 24 p refs
(Contract F49620-79-C-0074; AF Proj. 2301)
(AD-A091961; EOARD-TR-80-15) Avail: NTIS HC A02/MF A01 CSCL 20/12

Grain boundary diffusion and surface diffusion were studied, concentrating on Ge films on thin polycrystalline Al films. Measurements of the microstructure of the films and their geometrical parameters were made by transmission electron microscopy (TEM) and diffusion was measured by Auger electron spectroscopy (AES). Values for the diffusion coefficients and activation energy were obtained. Qualitative results are presented for sample preparation methods, the effect of oxidation of the Al film on Ge diffusion on and through the film and diffusion in GaAs/Al systems. Applications of the results are also discussed. GRA

N81-16932# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SEMICONDUCTOR/LIQUID JUNCTIONS: MOLECULAR MANIPULATION OF INTERFACE ENERGETICS Final Report
Mark S. Wrighton 21 Nov. 1980 15 p refs
(Contract N00014-78-C-0630; NR Proj. 051-696)
(AD-A092623) Avail: NTIS HC A02/MF A01 CSCL 20/12

The research carried out during the two year period 8/01/78 - 7/31/80 focused on n-type semiconducting photoanodes prepared from naturally occurring, single-crystal MoS2 and synthetic single-crystal MoSe2. Work on 'textured' single-crystal (100) Si was initiated and additionally, preliminary study of Ti2 and SrTiO3 photoanode surfaces revealed interesting behavior that is being pursued. GRA

N81-16933# Hughes Research Labs., Malibu, Calif.
OPTICAL MICROWAVE INTERACTIONS IN SEMICONDUCTOR DEVICES Progress Report, 1 Jan. - 30 Sep. 1980
L. Figueroa, C. W. Slayman, and H. W. Yen Nov. 1980 91 p refs Sponsored in part by DARPA
(Contract N00173-78-C-0192)
(AD-A092690; Rept-7) Avail: NTIS HC A05/MF A01 CSCL 20/6

The results of an extensive characterization of high speed analog modulation of (GaAl)As injection lasers, high speed optical detectors, and mode locking of (GaAl)As injection lasers are presented. Commercial injection lasers were successfully modulated up to 5 GHz. The 5 GHz value represents a practical upper limit to the modulation bandwith of existing commercial lasers. The laser equivalent circuit was characterized and the parasitics were found to play a significant role in the high speed modulation of the injection laser. T.M.

N81-16934# Institut fuer Angewandte Festkoerperphysik der Fraunhofer Gesellschaft e.V., Freiburg im Breisgau (West Germany).
DYNAMIC PROPERTIES OF INTERFACE STATES IN MOS-STRUCTURES Final Technical Report, Sep. 1979 - May 1980
E. Klausmann and A. Goetzberger Mar. 1980 44 p refs
(Contract DAJA37-79-C-0547; DA Proj. 1T1-61102-BH-57)
(AD-A092626) Avail: NTIS HC A03/MF A01 CSCL 20/12

With the CC-DLTS (Constant Capacitance Deep Level Transient Spectroscopy) method the energy distribution of the interface state density and the capture cross sections of MOS structures can be determined. A new evaluation procedure for this method was developed. The procedure used hetherto was based on rather restrictive assumptions and therefore provided results of lesser reliability. The new procedure requires more experimental data than the previous one, because one had overlooked that the basic equations possess more than one solution. The limits of the new procedure are outlined. A full evaluation for the energy distribution of both the interface state density and the capture cross sections is in the reach of today's instrumental means if N sub ss is somewhat greater than 10 to the 10th power/V/sq. cm. The previous method has a semi-quantitative character. Though it yields interface state densities down to 10 to the 9th power/V/sq. cm., it does not permit evaluation of capture cross sections and energy distribution. An experimental comparison of the CC-DLTS and conductance methods is presented. GRA

N81-16935# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
A15 SUPERCONDUCTORS THROUGH DIRECT SOLID-STATE PRECIPITATION: V3Ga AND Nb3Al Ph.D. Thesis
Minghwei Hong Sep. 1980 179 p refs
(Contract W-7405-eng-48)
(LBL-11021) Avail: NTIS HC A09/MF A01

The use of a solid-state precipitation process to prepare superconducting tapes containing an A15 phase, V3Ga or Nb3Al in a ductile niobium or vanadium containing BCC matrix is discussed. Ingots were prepared by arc-melting, homogenized, quenched, warm-rolled over 99% into tape and aged at temperatures in the range 600 C - 1000 C to precipitate the superconducting A15 phase. In the V-Ga system, transmission electron microscopy (TEM) studies revealed the A15 precipitates in an elongated form. However, for the Nb-Al samples deformed and aged at 750 C, TEM studies revealed A15 precipitation in fine equi-axed particles which formed as a semicontinuous network over sub-grain boundaries formed by the recovery of deformation-induced dislocations. In the V-Ga system, the maximum critical transition temperature (15 K) was found in materials aged at temperatures of 750 C or below. At these aging temperatures the T sub C initially increased with aging time and passed through a distinct maximum. In the Nb-Al system and T sub C increased with aging time to a plateau and then increased again to a second plateau. The maximum T sub C measured was 17 K. Promising high-field overall critical currents were obtained in the Nb-Al system. M.G.

N81-16936# Minnesota Univ., Minneapolis.
MEASUREMENT OF NEAR NEIGHBOR SEPARATIONS OF SURFACE ATOMS Progress Report
P. I. Cohen [1980] 21 p refs
(DOE/ER-10583/1) Avail: NTIS HC A02/MF A01

Appearance potential spectroscopy and energy loss spectroscopy are techniques under development for measuring the nearest neighbor distances of atoms on solid surfaces. Both measure extended fine structure in the excitation probability of core level electrons which are excited by an incident electron beam. Each technique has different advantages; the combination of the two enhances confidence in the results by reducing systematic error in the data analysis. The advantage of detecting selected X-rays on secondary electrons are discussed and solid state detectors being tested are described. A.R.H.

N81-16937# Mound Lab., Miamisburg, Ohio.
NMR STUDIES OF STRUCTURE AND DIFFUSION IN TITANIUM INTERMETALLIC HYDRIDES
R. C. Bowman, Jr. 1979 19 p
(Contract DE-AC04-76DP-00053)
(MLM-2787-OP) Avail: NTIS HC A02/MF A01

The relationships among hydride crystal structure, alloying, hydrogen interstitial site occupancy, and diffusion behavior are explored in several ternary metal hydride phases where titanium is a major component. The specific hydrides considered include: TiCuH sub x, TiFeH sub x, and TiCr2H sub x. The temperature dependencies of proton relaxation time were over accessible regions between 100 K and 570 K to characterize the hydrogen diffusion parameters. A wide diversity occurs with diffusion coefficients spanning several orders of magnitude. The roles of structure and hydrogen site occupancy on the diffusion mechanisms are discussed. M.G.

N81-16938# Oak Ridge National Lab., Tenn. Solid State Div.
PULSED-LASER ANNEALING OF ION-IMPLANTED GaAs:

THEORY AND EXPERIMENT
R. F. Wood, Douglas H. Lowndes, and W. H. Christie Nov. 1980 9 p refs
(Contract W-7405-eng-26)
(CONF-801124-30-DRAFT) Avail: NTIS HC A02/MF A01

It is shown that, in the pulsed-laser irradiation of crystalline or lightly damaged GaAs, good agreement is obtained between measured and calculated thresholds for melting, for catastrophic damage due to vaporization, and for the duration of surface melting at various energy densities. Good agreement between theory and experiment is also obtained for dopant profile spreading during pulsed-laser annealing. Author

N81-16939# Oak Ridge National Lab., Tenn. Solid State Div.
LASER INDUCED DEFECTS AND MATERIALS INTERACTIONS IN THE V-Si SYSTEM
B. R. Appleton, B. Stritzker (Inst. fur Festkorforschung, KFA, Julich, Germany), C. W. White, J. Narayan, J. Fletcher, O. Meyer (Nuclear Research Center, Karlsruhe, Germany), and S. S. Lau (California Univ. at San Diego, La Jolla) 1980 8 p refs
(Contract W-7405-eng-26)
(CONF-801124-34) Avail: NTIS HC A02/MF A01

Pulsed laser annealing was evaluated as a technique for fabricating superconducting V3Si from multilayer V-Si samples, and the nature of laser induced defects in V3Si single crystals was examined. Correlated analyses by ion scattering, ion channeling, Tc measurements and TEM were used to examine the composition and structure of samples subjected to single and multiple laser pulses. It was observed that although the superconducting A15 phase could be formed by pulsed laser mixing, the associated rapid quenching effects introduced defects which were not completely removed by thermal annealing to 925 K for 1 hour. Ion channeling and TEM studies of V3Si single crystals showed that pulsed laser irradiation caused microcracks to develop in the surface, probably from mechanical stresses induced by thermal gradients. Author

N81-16940# National Bureau of Standards, Washington, D.C. National Measurement Lab.
STANDARDS X-RAY DIFFRACTION POWDER PATTERNS. SECTION 17: DATA FOR 54 SUBSTANCES Final Report
Marlene C. Morris, Howard F. McMurdie, Eloise H. Evans, Boris Paretzkin, Camden R. Hubbard, and Simon J. Carmel Oct. 1980 119 p refs Prepared in cooperation with International Centre for Diffraction Data, Swarthmore, Pa.
(PB81-103269; NBS-MONO-25-SECT-17; LC-53-61386) Avail: NTIS HC A06/MF A01 CSCL 20B

Standard X-ray diffraction patterns are presented for 54 substances. The experimental X-ray powder diffraction patterns were obtained with an X-ray diffractometer. All d values were assigned Miller indices determined by comparison with computed interplanar spacings consistent with space group extinctions. The densities and lattice constants were calculated and the refractive indices were measured in some cases. GRA

N81-16941 Georgetown Univ., Washington, D.C.
STIMULATED RAYLEIGH SCATTERING IN SOLIDS Ph.D. Thesis
Patrick Robert Manzo 1980 101 p
Avail: Univ. Microfilms Order No. 8101470

The hypothesis that stimulated Rayleigh line scattering occurs in solids is tested by the following: (1) existing theory was reviewed; (2) approximate wavelength shifts which might be encountered were calculated; (3) experimental apparatus was designed fabricated, and tested; (4) appropriate materials were selected and prepared; (5) measurements were taken; (6) the experimental data was analyzed. Stimulated Rayleigh line scattering does occur in transparent cyrstalline solids in particular in crystalline quartz and in sapphire. It probably occurs in amorphous solids such as fused silica. The threshold for SRLS was less than 125 MW square centimeter for the samples tested. At high enough intensities nonlinear absorption takes place and the scattering switches to STRS, which was detected in all three solids tested. In those solids in which SRLS was detected, it occurred only within certain intensity limits. For SRLS to occur, the intensity had to be greater than the threshold for SRLS but less than the threshold for nonlinear absorption initiated STRS. Dissert. Abstr.

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N81-16942# California Univ., Livermore. Lawrence Livermore Lab.
THE HIGH TEMPERATURE ENTHALPIES OF ZINC SULFATE AND ZINC OXY-SULFATE
Pamela K. Hosmer and Oscar H. Krikorian 23 Jun. 1980 37 p refs Presented at 7th European Thermophys. Properties Conf., Antwerp, 30 Jun. - 4 Jul. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84562; CONF-800670-2) Avail: NTIS HC A03/MF A01

The high temperature enthalpies (500-1200 K) of zinc sulfate and zinc oxy-sulfate were measured using a drop calorimeter. The data includes determination of the transformation enthalpy associated with the alpha to beta phase transition of zinc sulfate which occurs at approximately 1015 K. This information extends the range of thermodynamic information for zinc sulfate into the temperature regime where zinc sulfate decomposition becomes significant and has useful applications in thermochemical cycles for the production of hydrogen. Author

N81-16943# Oak Ridge National Lab., Tenn.
ETFOD: A POINT MODEL PHYSICS CODE WITH ARBITRARY INPUT
K. E. Rothe and S. E. Attenberger 1980 77 p refs Sponsored by DOE
(ORNL/CSD/TM-119) Avail: NTIS HC A05/MF A01

A zero dimensional code, ETFOD, is described which solves a set of physics equations by minimization. The technique used is different in that the input is arbitrary. The user is supplied with a set of variables from which he specifies which variables are input (unchanging). The remaining variables become the output. The code is written in a manner to allow easy modification of equations, variables, and physics calculations. The solution technique is presented along with suggestions for using the code. M.G.

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N81-16944# Army Missile Command, Redstone Arsenal, Ala. Technology Integration Office.
A METHODOLOGY FOR AGGREGATION OF MULTIPLE CRITERIA RANK-ORDERED PRIORITIES
Edward B. Dobbins May 1980 206 p refs
(AD-A091884; AD-E950034; DRSMI/RN-80-3-MR) Avail: NTIS HC A10/MF A01 CSCL 05/1

This report is concerned with the aggregation of multiple rank-ordered research and development projects or product

requirements. The resultant prioritized list serves as a resource allocation basis for the R D projects. The rank orders are ordinal and without feedback or strategy. The extensive literature of the social choice field is structured and analyzed for this research. Building upon that foundation, this research classified the known majority-rule aggregation methods, evaluated them, and developed a model and computer code using the better methods to compute the aggregation of up to 100 rank-ordered lists of up to 100 alternatives. Decision-maker and alternative weighting may be applied by any of eight methods. Judge self-evaluation weighting is also available. Final rank-ordered priority lists of R D projects are computed by the Borda, Adjusted Borda, and Shannon Majority-Rule methods. The preferred Shannon method handles complete, partial, and weighted rank orders without transitivity. Fuzzy set rank orders are compared. Kendall's coefficients of consistency and concordance evaluate the rank orders. The model is validated by comparative computation of many rank-ordered aggregation examples from the literature. GRA

N81-16945# Oak Ridge National Lab., Tenn. Technical Publications Dept.

DEVELOPING A COMPUTERIZED TEXT-MANAGEMENT SYSTEM - THE ORNL EXPERIENCE

James David Mason 1980 9 p

(Contract W-7405-eng-26)

(CONF-801113-4) Avail: NTIS HC A02/MF A01

A high speed third generation phototypesetter was developed at the Oak Ridge National Laboratory. Reasons for the development of the system were reviewed with particular emphasis on the need for publishing an ever increasing number of technical documents. The computer system's design is described and is broken into four major parts: training, word processing, editing, and composition. T.M.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N81-16946# SOCIALDATA, Inst. fuer Empirische Sozialforschung G.m.b.H., Munich (West Germany).

INDIVIDUAL INFORMATION STRATEGIES IN THE FIELD OF SCIENTIFIC AND TECHNICAL INFORMATION, WITH SPECIAL REGARD TO THE USE OF AUTOMATIC DATA PROCESSING Final Report

Jorg Becker, B. Mettler-Meibom, J. Matheisen, and I. Sommer-Becker Aug. 1980 145 p refs In GERMAN; ENGLISH Summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-ID-80-008) Avail: NTIS HC A07/MF A01 CSCL 05B

Research which has been undertaken so far about individual information strategies in scientific and technical communication, particularly with regard to automatic data processing was analyzed. Areas of insufficient research are identified ideas how to orient research in the respective areas are presented. Hypothetical conclusions about the determinating dimensions of individual information behavior are considered. The need for further research is indicated to determine: (1) individual information strategies (empirical study); (2) organizational and institutional framework of individual information strategies; (3) structural comparison of the US and Germany system scientific and technical communication; and (4) the interrelation between personal communication and communication by media. A.R.H.

N81-16947*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A REVIEW AND EVALUATION OF THE LANGLEY RESEARCH CENTER'S SCIENTIFIC AND TECHNICAL INFORMATION PROGRAM. RESULTS OF PHASE 1: KNOWLEDGE AND ATTITUDES SURVEY, LaRC RESEARCH PERSONNEL Final Report

Thomas E. Pinelli, Myron Glassman (Old Dominion Univ., Norfolk, Va.), and Edward M. Cross (Old Dominion Univ., Norfolk, Va.) Nov. 1980 74 p refs

(NASA-TM-81893) Avail: NTIS HC A04/MF A01 CSCL 05B

The effectiveness of the Langley STI program was assessed using feedback obtained from Langley engineers and scientists. A survey research procedure was conducted in two stages. Personal interviews with 64 randomly selected Langley engineers and scientists were used to obtain information for questionnaire development. Data were then collected by means of the questionnaire which covered various aspects of the Langley STI program, utilized both open and closed ended questions and was pretested for finalization. The questions were organized around the six objectives for Phase 1. The completed questionnaires were analyzed. From the analysis of the data, recommendations were made for improving the Langley STI program. A.R.H.

N81-16948# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

AN OPTIMALITY THEORY OF CONCURRENCY CONTROL FOR DATABASES

Hsing-Tsung Kung and Christos H. Papadimintriou Nov. 1980 19 p refs Prepared in cooperation with MIT

(Contract N00014-76-C-0370; Grants NSF MCS-77-01193; NSF MCS-75-22255; NSF MCS-77-05314)

(AD-A092625; MIT/LCS/TM-185) Avail: NTIS HC A02/MF A01 CSCL 09/2

A concurrency control mechanism (or a scheduler) is the component of a database system that safeguards the consistency of the database in the presence of interleaved accesses and update requests. We formally show that the performance of a scheduler, i.e., the amount of parallelism that it supports, depends explicitly upon the amount of information that is available to the scheduler. We point out that most previous work on concurrency control is simply concerned with specific points of the base trade-off between performance and information. In fact, several of these approaches are shown to be optimal for the amount of information that they use. GRA

N81-16949# Midwest Research Inst., Golden, Colo.

A BROAD KNOWLEDGE OF INFORMATION TECHNOLOGIES: A PREREQUISITE FOR THE EFFECTIVE MANAGEMENT OF THE INTEGRATED INFORMATION SYSTEM

Herbert Landau Sep. 1980 9 p Presented at the 12th Ann. Meeting of the Western Canada Chapter of ASIS, Saskatchewan, 25 Sep. 1980

(Contract EG-77-C-01-4042)

(SERI/TP-750-926; CONF-800986-1) Avail: NTIS HC A02/MF A01

There is a trend towards the bringing together of various information technologies into integrated information systems. The managers of these total systems therefore must be familiar with each of the component technologies and how they may be combined into a total information system. To accomplish this, the manager should first define the overall system as an integrated flow of information with each step identified; then, the alternate technologies applicable to each step may be selected. Methods of becoming technologically aware are suggested and examples of integrated systems are discussed. Author

N81-16950# Science and Education Administration, Beltsville, Md.

KEYWORD BANK IN CRIS: TERMS FOR INDEXING AND RETRIEVING RESEARCH PROJECTS IN THE CURRENT RESEARCH INFORMATION SYSTEM

Jul. 1980 126 p

(PB81-101735) Avail: NTIS HC A07/MF A01 CSCL 05B

A list of keywords used for indexing and automated retrieval of research projects documented in the Current Research Information System (CRIS) is provided. This list of about 15,000 terms is based on keywords derived from the 1978 CRIS file of agricultural and forestry research projects of the U.S. Department of Agriculture, the State Agricultural Experiment stations and other cooperating State institutions. Keywords are arranged alphabetically with each entry showing the number of projects to which the keyword was posted. It includes an appendix which

lists the CRIS agricultural and forestry classifications and their associated retrieval codes. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N81-16951*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ASSESSMENT OF POTENTIAL FUTURE HYDROGEN MARKETS IN THE U.S.
Ali K. Kashani Sep. 1980 65 p refs
(Contracts NAS7-100; ET-78-1-01-3112)
(NASA-CR-163895; JPL-Pub-80-68) Avail: NTIS HC A04/MF A01 CSCL 05C

Potential future hydrogen markets in the United States are assessed. Future hydrogen markets for various use sectors are projected, the probable range of hydrogen production costs from various alternatives is estimated, stimuli and barriers to the development of hydrogen markets are discussed, an overview of the status of technologies for the production and utilization of hydrogen is presented, and, finally, societal aspects of hydrogen production and utilization are discussed. S.F.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N81-16952# Committee on Science and Technology (U. S. House).
POSTURE HEARINGS (NASA AND FAA)
Washington GPO 1980 110 p Hearing before the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 112, 29 Jan. 1980
(GPO-65-265) Avail: Committee on Science and Technology

Highlights of NASA activities in the 1960's and 1970's are assessed and plans for the 1980's are examined in the light of the President's proposed NASA budget of $5.737 billion for fiscal year 1981 and a supplemental fiscal year 1980 approximation of $300 million for space shuttle development. Planning for other programs, in addition to the space transportation system, is described. The status of the FAA engineering and developing program is also reviewed. Difficulties in maintaining adequate staffing are discussed. A.R.H.

N81-16953# Committee on Science and Technology (U. S. House).
NASA AUTHORIZATION, 1981
Washington GPO 1980 204 p Index for Hearings on H. R. 6413 before the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 158, for v. 1-5
(GPO-71-290) Avail: Committee on Science and Technology

A subject and name index is provided for testimony delivered and statements received in support of NASA's request for funding for research and development, program management and construction of facilities. A.R.H.

N81-16954*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE RULES IMPLEMENTING SECTIONS 201 AND 210 OF THE PUBLIC UTILITY REGULATORY POLICIES ACT OF 1978: A REGULATORY HISTORY
Robert N. Danziger 15 Sep. 1980 184 p
(Contract NAS7-100; EX-76-A-29-1012)
(NASA-CR-163900; DOE/JPL-1012-48; JPL-Pub-80-64) Avail: NTIS HC A09/MF A01 CSCL 05D

The act provides that utilities must purchase power for qualifying producers of electricity at nondiscriminatory rates. It exempts private generators from virtually all state and federal utility regulation. Pertinent reference material is provided. T.M.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N81-16955*# Kansas Univ. Center for Research, Inc., Lawrence.
AN INVESTIGATION OF DRAG REDUCTION FOR TRACTOR TRAILER VEHICLES WITH AIR DEFLECTOR AND BOATTAIL Final Report
Vincent U. Muirhead Jan. 1981 68 p refs
(Grants NsG-4021; NsG-4023)
(NASA-CR-163104; KU-FRL-406-1) Avail: NTIS HC A04/MF A01 CSCL 13F

A wind tunnel investigation was conducted to determine the influence of several physical variables on the aerodynamic drag of a trailer model. The physical variables included: a cab mounted wind deflector, boattail on trailer, flow vanes on trailer front, forced transition on trailer, and decreased gap between tractor and trailer. Tests were conducted at yaw angles (relative wind angles) of 0, 5, 10, 20, and 30 degrees and Reynolds numbers of 3.58 x 10 to the 5th power 6.12 x 10 to the 5th power based upon the equivalent diameter of the vehicles. The wind deflector on top of the cab produced a calculated reduction in fuel consumption of about 5 percent of the aerodynamic portion of the fuel budget for a wind speed of 15.3 km/hr (9.5 mph) over a wind angle range of 0 deg to 180 deg and for a vehicle speed of 88.5 km/hr (55 mph). The boattail produced a calculated 7 percent to 8 percent reduction in fuel consumption under the same conditions. The decrease in gap reduced the calculated fuel consumption by about 5 percent of the aerodynamic portion of the fuel budget. Author

N81-16956# Committee on Science and Technology (U. S. House).
MUNICIPAL SOLID WASTE TO ENERGY ACT OF 1979
Washington GPO 1980 220 p refs Hearings on S. 1934 before the Subcomm. on Energy Conserv. and Supply of the Comm. on Energy and Nat. Resources, 96th Congr., 2nd Sess. 27-28 Feb. 1980
(GPO-60-684; Publ-96-99) Avail: Subcommittee on Energy Conservation and Supply

A bill is discussed which is designed to promote the construction and operation of facilities for solid waste utilization. Among its provisions is a price support loan program for municipal solid waste to energy systems. Grants in the amount of $12 million are authorized for states and local subdivisions, to evaluate the feasibility of various resource recovery alternatives in given communities. A.R.H.

N81-16957# New York Univ., N. Y. Center for Science and Technology Policy.
FLOW OF TECHNOLOGY FROM THE OECD TO THE USSR: A FEASIBILITY STUDY
Herbert I. Fusfeld Jan. 1980 38 p refs
(AD-A092442; FAR-30000) Avail: NTIS HC A03/MF A01 CSCL 05/2

This report (1) evaluates the feasibility for conducting a study of the relative value to the U.S.S.R. of technology obtained by direct exchanges with the U.S., and (2) discusses the availability, accessibility, and probable contribution of published and unpublished sources of information and data necessary to carrying out the project. Our conclusion is that the basic objective is indeed feasible, and the originally proposed program of value, for these reasons: (1) adequate information is, or will be made, available; (2) the specific analysis recommended has not been previously performed; (3) current research programs at other institutions are not addressing these specific questions; and (4) the results will provide a valuable basis for broader discussions and analyses. GRA

N81-16958# Argonne National Lab., Ill. Transportation Energy Systems Sect.

TECHNOLOGY ASSESSMENTS IN TRANSPORTATION: SURVEY OF RECENT LITERATURE
Sarah J. LaBelle Mar. 1980 245 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV-TM-44) Avail: NTIS HC A11/MF A01

A survey and an evaluation of recent studies of transportation systems done in a technology assessment framework were undertaken as the basis for a detailed statement for a technology assessment of transportation energy conservation strategies. Several bibliographies were searched and numerous professionals in the field of technology assessment were contacted regarding current work. Detailed abstracts were prepared for studies judged to be sufficiently broad in coverage of impacts assessed, yet detailed in coverage of all or part of the nation's transportation systems. Some studies were rich in data but not comprehensive in their analytical approach; brief abstracts were prepared for these. An explanation of the criteria used to screen the studies, as well as abstracts of 37 reports, are provided in this compendium of transportation technology assessment literature. Author

N81-16959# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
VEHICLE ATTRIBUTES CONSTRAINING PRESENT ELECTRIC CAR APPLICABILITY IN THE FLEET MARKET
Joseph R. Wagner Dec. 1979 18 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51099) Avail: NTIS HC A02/MF A01

One strategy for reducing petroleum imports is the use of electric cars in place of conventional vehicles. Obstacles which electric cars are likely to encounter in attempting to penetrate a key segment of the passenger car market, namely, the fleet market are examined. A fleet is defined as a group of cars operated by a corporation or a government agency. The primary data source is a questionnaire that was distributed to fleet operators. Six sectors of the fleet market were sampled: police; state and local government; utilities; taxi; rental; and business. The questionnaire was specifically designed to uncover factors limiting market penetration of unconventional vehicles, although no attempt was made to determine price elasticities. Emphasis is on vehicle attributes that are readily quantifiable and relatively projectable, including seating capacity, range, battery recharging characteristics, availability of power options, and ability to use interstate highways. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N81-16960*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUBMILLIMETER WAVE SURVEY OF THE GALACTIC PLANE Ph.D. Thesis - Maryland Univ.
Lim H. Cheung Dec. 1980 223 p refs
(NASA-TM-82056) Avail: NTIS HC A10/MF A01 CSCL 03B

The survey measured, over virtually the entire galactic plane, the distribution and basic physical conditions of the coolest dust component of the interstellar medium. The instrument designed for observations of extended, low surface brightness continuum emission consisted of a balloon borne, gyro stablized, 1.2 m Cassegrain telescope and a liquid cooled photometer. The design, integration, tests, and flight operation of the survey are presented. T.M.

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

No abstracts in this category.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N81-16961* National Aeronautics and Space Administration, Washington, D. C.
VOYAGER SATURN ENCOUNTER PRESS BRIEFING
28 Oct. 1980 49 p
(P80-10213) Avail: NASA Scientific and Technical Information Facility. P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 03B

The briefing reviewed the mission planning of the Voyager project. The near encounter trajectories of both Voyager spacecraft were examined. The Saturn system is discussed with particular emphasis on Saturn's moons. T.M.

N81-16962*# Planetary Science Inst., Pasadena, Calif.
PHOTOGEOLOGICAL CONSTRAINTS ON LUNAR AND PLANETARY VULCANISM, PART 1 Final Report, 7 Dec. 1978 - 7 Dec. 1979
Nov. 1979 106 p refs
(Contract NASw-3051)
(NASA-CR-163901) Avail: NTIS HC A06/MF A01 CSCL 03B

Central volcanic constructs were studied as constraints on the thermal evolution and regional tectonics of the Moon and terrestrial planets. The origins of sub-kilometer lunar craters were examined with regards to implications for mare basalt petrogenesis. The morphology, distribution, age, and tectonic setting of the volcanic constructs were studied using Viking Orbiter data. T.M.

N81-16963*# Planetary Science Inst., Pasadena, Calif.
PHOTOGEOLOGICAL CONSTRAINTS ON LUNAR AND PLANETARY VULCANISM, PART 2 Final Report, 7 Dec. 1978 - Dec. 1979
5 Dec. 1980 120 p refs
(Contract NASw-3051)
(NASA-CR-163902) Avail: NTIS HC A06/MF A01 CSCL 03B

The use of several simple theoretical modelling approaches in simulating lava erosion were evaluated. Both one dimensional and two dimensional models were used with the two dimensional model being superior. The two dimensional model accounts, in a purely phenomenological way, for the effects of turbulence and mechanical erosion in a flow. Criteria for mechanical erosion was related to the basal stress and the effect of entrained eroded material on fluid properties was parameterized. T.M.

N81-16964*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE COMET HALLEY HANDBOOK: AN OBSERVER'S GUIDE
Donald K. Yeomans 15 Jan. 1981 49 p refs
(NASA-CR-163876) Avail: NTIS HC A03/MF A01 CSCL 03B

The orbit of Comet Halley is described as well as its expected physical behavior (brightness, tail lengths, coma diameters) in 1985-1986 during which time its preperihelion positon will allow better conditions for Northern Hemisphere observers. Southern

Hemisphere observers will prefer post perihelion observation. Ephemeris data for 1981-1987 are presented in tables. A.R.H.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N81-16965*# California Univ., Los Angeles. Dept. of Astronomy.
THE SOLAR GRAVITATIONAL FIGURE: J2 AND J4 Final Report
R. K. Ulrich and G. W. Hawkins 1980 12 p refs Prepared for JPL
(Contract JPL-955839)
(NASA-CR-163881; JPL-9950-459) Avail: NTIS HC A02/MF A01 CSCL 03B

The theory of the solar gravitational figure is derived including the effects of differential rotation. It is shown that J sub 4 is smaller than J sub 2 by a factor of about 10 rather than being of order J sub 2 squared as would be expected for rigid rotation. The dependence of both J sub 2 and J sub 4 on envelope mass is given. High order p-mode oscillation frequencies provide a constraint on solar structure which limits the range in envelope mass to the range 0.01 < M sub E/solar mass < 0.04. For an assumed rotation law in which the surface pattern of differential rotation extends uniformly throughout the convective envelope, this structural constraint limits the ranges of J sub 2 and J sub 4 in units of 10 to the -8th power to 10 < J sub 2 < 15 and 0.6 < J sub 4 < 1.5. Deviations from these ranges would imply that the rotation law is not constant with depth and would provide a measure of this rotation law. M.G.

N81-16966*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE LOCKHEED OSO-8 PROGRAM. TASK 2: ANALYSIS OF DATA FROM THE HIGH RESOLUTION ULTRAVIOLET SPECTROMETER EXPERIMENT Final Report, 19 Nov. 1977 - 31 Aug. 1980
E. C. Bruner, Jr. 30 Sep. 1980 80 p refs
(Contract NAS5-22411)
(NASA-CR-163918; LMSC-D766867) Avail: NTIS HC A05/MF A01 CSCL 03B

The complete set of C 4 time sequences generated by the University of Colorado high resolution ultraviolet spectrometer experiment on OSO-8 were examined in a comprehensive and systematic fashion. As a result a new limit is placed on the acoustic flux passing through the transition zone of the Sun's atmosphere. It is found to be three orders of magnitude too small to heat the corona, and is consistent with zero. In collaborative efforts, the properties of transient C 4 brightenings were examined in considerable detail. J.M.S.

N81-16967# National Bureau of Standards, Boulder, Colo. Center for Applied Mathematics.
STATISTICAL METHODS FOR SOLAR FLARE PROBABILITY FORECASTING Final Report, Jun. 1979 - Feb. 1980
Dominic F. Vecchia, Peter V. Tryon, Ginger A. Caldwell, and Richard W. Jones Sep. 1980 82 p refs
(AF Proj. 2311)
(AD-A092708; AFGL-TR-80-0336) Avail: NTIS HC A05/MF A01 CSCL 03/2

The Space Environment Services Center (SESC) of the National Oceanic and Atmospheric Administration provides probability forecasts of regional solar flare disturbances. This report describes a statistical method useful to obtain 24 hour solar flare forecasts which, historically, have been subjectively formulated. In Section 1 of this report flare classifications of the SESC and the particular probability forecasts to be considered are defined. In Section 2 we describe the solar flare data base and outline general principles for effective data management. Three statistical techniques for solar flare probability forecasting are discussed in Section 3, viz, discriminant analysis, logistic regression, and multiple linearregression. We also review two scoring measures and suggest the logistic regression approach for obtaining 24 hour forecasts. In Section 4 a heuristic procedure is used to select nine basic predictors from the many available explanatory variables. Using these nine variables logistic regression is demonstrated by example in Section 5. We conclude in Section 6 with band broad suggestions regarding continued development of objective methods for solar flare probability forecasting. GRA

N81-16968# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 431, JULY 1980. PART 2 (COMPREHENSIVE REPORTS): DATA FOR JANUARY 1980, JUNE 1979 AND MISCELLANEA
Helen E. Coffey, ed. Jul. 1980 78 p refs
(PB81-110025; SGD-431-Pt-2; NOAA-80090902) Avail: NTIS HC A05/MF A01 CSCL 03B

Data for January 1980 on solar radio emission and solar X-ray radiation are presented along with data on solar flares for June 1979. The miscellaneous data consists of May 1979 regional flare index, active regions Oct 6-Nov 3, 1979, and synoptic solar maps Oct 6-Nov 3, 1979. GRA

N81-16969# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 431, JULY 1980. PART 1 (PROMPT REPORTS): DATA FOR JUNE 1980, MAY 1980 AND LATE DATA
Helen E. Coffey Jul. 1980 175 p
(PB81-110017; SGD-431-Pt-1; NOAA-80090901) Avail: NTIS HC A08/MF A01 CSCL 03B

Data are provided for June 1980 on: alert periods, daily solar indices, solar flares, solar radio emission, solar wind measurements, spacecraft observations, mean solar magnetic field, and Boulder Geomagnetic Substorm Log. Data are also presented for May 1980 on: daily solar activity centers, sudden ionospheric disturbances, spacecraft observations, solar radio emission, cosmic rays, geomagnetic indices, and radio propagation indices. Late data include spacecraft observations for May 1980, daily solar activity centers, cosmic rays Huancayo April 1980, and geomagnetic indices. GRA

N81-16970 Washington Univ., Seattle.
THREE-DIMENSIONAL PLASMA CHARACTERISTICS OF ION BEAMS IN THE SOLAR WIND Ph.D. Thesis
Christopher Allan Gurgiolo 1980 126 p
Avail: Univ. Microfilms Order No. 8029758

At times, early in the flight of ISEE 1 & 2, the ion fluxes from the electrostatic analyzers showed a noticeable spin associated modulation, particularly in the upstream region. Analysis of this data led to the conclusion that modulations in the count rate are produced when the distribution function has a sharp gradient in phase space. Matching the modeled count rates to the data permits estimating the plasma parameters contained in the distribution function: the temperatures, the three dimensional flow velocity, and the density. The results can be summarized as follows: (1) multiple ion beams exist upstream of the Earth's bow shock; (2) the temperature of these beams ranges from solar wind type temperatures of 5 eV up to 70 or 80 eV; (3) these beams are different from those observed by other experimenters in that they have a three dimensional flow in an electric field free reference frame; (4) the beams are comprised of a small percentage of solar wind ions which have been reflected at the bow shock; and (5) the plasma characteristics of these beams are highly time dependent suggesting that the shock surface may contain rapidly changing field structures. Dissert. Abstr.

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see 52 Aerospace Medicine. For theory see *73 Nuclear and High-Energy Physics.*

N81-16971*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
***INTERPRETATIONS AND IMPLICATIONS OF GAMMA RAY* LINES FROM SOLAR FLARES, THE GALACTIC CENTER**

IN GAMMA RAY TRANSIENTS

R. Ramaty and R. E. Lingenfelter (California Univ., San Diego, La Jolla) Nov. 1980 40 p refs Presented at the Roy. Soc. Meeting on Gamma Ray Astronomy, 27-28 Nov. 1980 Submitted for publication

(Grants NsG-7541; NSF AST-79-11987)

(NASA-TM-82066) Avail: NTIS HC A03/MF A01 CSCL 03B

Observations and theories of astrophysical gamma ray line emission are reviewed and prospects for future observations by the spectroscopy experiments on the planned Gamma Ray Observatory are discussed. Author

N81-16972*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS OF SAMPLING AND RADIATION BALANCES: THEIR PROBLEMATICS

D. Crommelynck (Royal Inst. of Meteorology of Belgium, Brussels) Jun. 1980 18 p Transl. into ENGLISH of "Problemes d'Echantillonnage et Bilans Radiatices--leur Problematique" Rept. ESA - SP-150 Paris, Feb. 1980 p 95 - 102 Presented at an ESA Workshop on Climatol., Hydrol., Atmospheric Res. and Meteorol., Ajaccio, Corsica, 12-15 Nov. 1979 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by European Space Agency, Paris

(Contract NASw-3198)

(NASA-TM-75831; ESA-SP-150) Avail: NTIS HC A02/MF A01 CSCL 03B

Problems associated with the measurement of the Earth radiation balances are addressed. It is demonstrated that the knowledge of the different radiation budgets with their components is largely dependent on the space time sampling of the radiation field of the Earth atmosphere system. Whichever instrumental approach is adopted (wide angle view of high resolution) it affects the space time integration of the fluxes measured directly or calculated. In this case the necessary knowledge of the reflection pattern depends in addition on the angular sampling of the radiances. A series of questions is considered, the answers of which are a prerequisite to the the organization of a global observation system. M.G.

99 GENERAL

N81-16973*# National Aeronautics and Space Administration, Washington, D. C.

ASTRONAUTICS AND AERONAUTICS, 1975. A CHRONOLOGY

Nancy L. Brun and Eleanor H. Ritchie 1979 331 p

(NASA-SP-4020; LC-65-60308) Avail: NTIS MF A01; SOD HC $7.00 CSCL 05D

The major NASA launches are presented including the sounding rocket launches. Also included are the satellites, space probes, and manned space flights for the year. T.M.

N81-16974*# National Aeronautics and Space Administration, Washington, D. C.

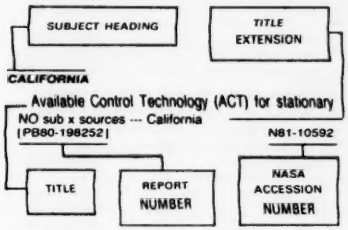
ANNUAL REPORT BY AEROSPACE SAFETY ADVISORY PANEL Annual Report

1980 57 p refs

(NASA-TM-82250) Avail: NTIS HC A04/MF A01 CSCL 05A

Elements of the shuttle program that directly affect the mission success and crew safety were investigated. These elements included the shuttle orbiter, the main engine, the solid rocket boosters, avionic system, ground support equipment and the approach and landing operations. The thermal protection systems were studied in detail. Crew training and ground simulation test procedures were reviewed. T.M.

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

A

A-7 AIRCRAFT
Abstract interface specifications for the A-7E device interface module
[AD-A092696] N81-16770

ABLATION
Ablation and ablative materials. Citations from the International Aerospace Abstracts data base
[NASA-CR-163915] N81-16143

ABLATIVE MATERIALS
Ablation and ablative materials. Citations from the International Aerospace Abstracts data base
[NASA-CR-163915] N81-16143

ABSORBERS (EQUIPMENT)
Absorbent product and articles made therefrom --- for collection of human wastes
[NASA-CASE-MSC-18223-1] N81-16127

ABSORBERS (MATERIALS)
An investigation into the mechanism of sound-energy absorption in a low-frequency modular absorber
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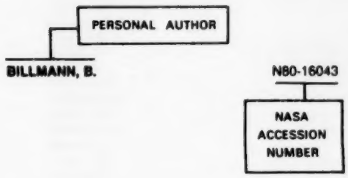

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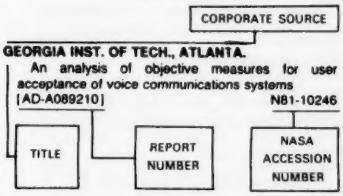

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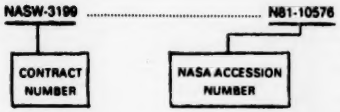

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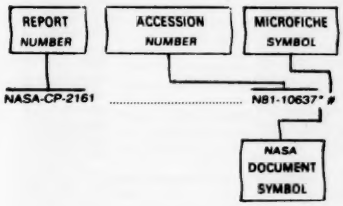

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